ENGINEERING NEWS

THE Board of Trustees of the New York & Brooklyn Bridge, at a special meeting called for Tuesday last, "to consider" the recommendations of the Board of Experts, rejected without discussion and unanimously the recommendations of the Board, and adopted without discussion and unanimously a modification of one of the rejected plans, of the "tail switching" (present) type, prepared since the experts' report was rendered, and which had consequently never been considered by them, although the type itself was condemned in their report. The new plans, as also the previously rejected plan, were prepared by Mr. C. C. MARTIN, Chief Engineer of the bridge, and provide for running 4-car trains over gauntleted tracks with double terminal platforms. The plan is not claimed to be of a permanent or expansible nature, but, is alleged to be sufficient for the next seven years. This action was had on the strength of estimates prepared by Mr. MARTIN, and shown to no one concerned off the Board of Trustees until the day of the meeting, alleging that the cost of carrying out the recommended plans would be $5,777,250 against $773,000 for the adopted plan.

As soon as these figures came to the knowledge of Mr. WELLINGTON he immediately addressed to President HOWELL the communication which appears in another column, claiming that this estimate was a gross and palpable exaggeration of nearly $4,000,000 in obvious items, for a comparison on equal terms, besides neglecting a large contrast in operating expenses, and demanding that the new plans and alleged estimates be referred with the rest to the old or a new Board of Experts. What action will be had remains to be seen, and under the circumstances it appears proper for us to refrain entirely from editorial comment, and leave our readers to judge of the propriety of this action for themselves.

THE Brooklyn Rapid Transit Commission have laid out two new routes in Brooklyn, one running down from Newtown creek at Long Island City close to the East River to Myrtle Ave., and one which is practically an extension of the Fulton Ave. line further out in the country. The last line at least, it is understood, will be built at once.

FURTHER details of Mr. HEMAN CLARK'S scheme are, that it is to start near Fleetwood Park, cross the Harlem 150 ft. below the water line, follow Fifth Avenue and Central Park to Washington Square, and thence run parallel with Broadway to City Hall Park. It is there to branch into (1) a North River tunnel, emerging back of the Palisades, and (2) an East River tunnel emerging back of Prospect Park and Greenwood Cemetery. Mr. CLARK computes that 20 miles of road with full equipments will cost $30,000,000. The Board of Aldermen in a spasm of common sense, have refused to take any action as to this plan until the fate of Mayor HEWITT'S pending Rapid Transit bill is determined.

DURING the week more damage has been caused by the high water in the rivers in the Northwest, especially in Minnesota. A dam at Forest City, Minn., was destroyed, and another at Red Lake Falls seriously damaged. At Wabasha, Minn., a railway pontoon bridge was carried away by the breaking up of the ice at the lower end of Lake Pepin, the ice cutting away the piles driven to protect the bridge. Three bridges have been carried away on Duck creek in the Oneida reservation, Wisconsin. It is reported that every bridge across the Zumbro river, in Wabasha Co., Minn., has been carried away, and every bridge across Le Sueur creek, in Le Sueur Co., Minn., either washed away or damaged.

THE most serious railway accident of the week was a head collision, April 15, on the Pennsylvania Railroad at Philadelphia, which repeats the lesson of the late accident near Jersey City, on the same road, that human vigilance alone cannot be relied on to prevent the disregard of the most conspicuous and carefully designed signals. An express train from New York for Washington ran into a light locomotive running westward on the same track near the 30th St. signal station; both engines were wrecked and 4 cars overturned. Nobody was killed but about 20 persons were injured, some seriously. The accident arose from forgetfulness by the driver of the light engine; the signals gave the express the right of way, but the light engine ran onto the same track from a siding and was struck while on the switch. A car stove was upset and the mail car and mail were burnt. An interlocking connection between the signals and switch would have prevented this part of the accident, but not the running past the signal.——On April 12 a construction train of 12 cars on the Kansas City, Memphis & Birmingham Railroad, near Amory, Miss., while running backward at a reported rate of 20 miles an hour, struck a cow, and the entire train was derailed and wrecked. Four men were killed outright and ten injured, some fatally.

THE great difficulty experienced in carrying out public improvements is forcibly illustrated by the slow progress which is being made by the Electrical Subway Commission in securing the removal of the electrical wires and poles from the streets of New York, and causing them to be placed in subways. As shown by an article in this issue, over 350 miles of trenches have been dug by the Commission, and provision has been made for the placing below ground of nearly 15,000 miles of wires. But with all these conduits in waiting, the telegraph, telephone, and electric light companies fail to remove their overhead wires to the subways, and so far, the law has not been able, or *enabled*, to make them do so. There are at present only two short sections of the subway in use, one in Sixth Ave., and another in lower Broadway. The wires in these are working well.

THE Lick Observatory is nearly ready for transfer to the University of California. Defects in the movable floor of the dome will be remedied by the use of four hydraulic rams which will move the floor at the rate of a foot per minute. The great telescope and spectroscope are now in good working order. Through the telescope this week have been observed plainly the two moons of Mars, which have diameters of only thirty miles. Out of $700,000 given by JAMES LICK, twelve years ago, there only remained, one year ago, $390,000. During the past year the expenditures were $250,000, so that when the observatory is turned over, there will not be more than $100,000 left. This, at six per cent. will realize $6,000 per year, whereas, to keep the observatory in decent repair and pay the salaries will require $50,000. The State University will be responsible for this, and it will be a heavy drain on the institution.

THE Annual Report of the Benevolent Fund of the Institution of Civil Engineers shows that during the past year there have been receipts from various sources amounting to $14,000. Of this, $13,300 was income proper, or interest on invested funds, and annual subscriptions paid in. The amount paid to applicants for assistance was about $11,500. The object of this fund is to help engineers who are in need of assistance either through sickness or lack of work. The grants are made by a committee who consider each application and keep the whole matter private. The fund consists of the donations made by the founders in 1864, of annual subscriptions, and of occasional donations and bequests. For 1887, the grants and expenses were just within the limit of receipts, so that no addition could be made to the reserve fund, which stands where it did four years ago, at about $45,000. The committee in charge state that in at least two instances the aid rendered from the fund enabled applicants to retain positions they must otherwise have lost.

THE latest despatches from the Nicaragua canal report the arrival from New York of the following additional engineers: J. H. COVODE, J. CLYDE POWER, chiefs of parties; BENJAMIN F. BATES, first assistant engineer; E. D. VERY, HENRY J. DODGE, second assistants; GEORGE F. POHLERS, rodman and draughtsman; W. H. PEARLBROOK, rodman. These men have been assigned to parties, and have left for their respective stations. Mr. POWER is chief of party No. 6 for the survey of the San Juan river from Fort San Carlos to Machuca rapids. He has for assistants, Mr. BATES as first, and Mr. VERY and Mr. DODGE as second. Mr. COVODE is chief of a party for the survey of part of the lower route. On March 19, parties No. 6, Mr. POWER chief, No. 5, Mr. J. F. PEREZ chief, and No. 3, Mr. J. G. HOLCOMB chief, started for Lake Nicaragua. Parties No. 3 and No. 5 having accomplished their work on the eastern part, will now survey the western division of the canal, from the mouth of the Rio Lajas to the Pacific ocean. The work on this division is for the purpose of completing the data already obtained with sufficient accuracy to make exact preliminary estimates. It is thought no changes of importance will be made in this part of the canal. Four locks are contemplated on this end and three on the other, with diversion of the Rio Grande and Rio Lajas, the latter will not be very large or costly work. Present estimates place the cost of the western division at $17,000,000. A hydrographic survey of the entrance to Lake Nicaragua by way of the San Juan river is now being made with Mr. W. J. MAXWELL as chief of the party.

Since writing the above, telegraphic despatches have been received at the office of the Nicaragua canal company from Lieut. A. C. MENOCAL, stating that he has arrived safely at the work on the canal. He has joined the party of Mr. PEARY, and with him is going over the results of the surveys made by this party in order to ascertain if a new survey of the entire region is necessary. From Lake Nicaragua to the eastern terminus two routes have been suggested. The point of divergence is about 25 miles from the lake. The upper proposed route is the shortest by 7 miles, but it is through rock, and presents difficult engineering features which the lower route does not have. Lieut. MENOCAL will make a careful examination of the two routes.

THE charter of incorporation for the Philadelphia & Reading Terminal Railroad Co., which is to reconstruct the terminals of the Reading Railroad in the city of Philadelphia has been filed at Harrisburg. The new station is to be built at Twelfth and Market Streets, on the site now occupied by the Farmers' Market, and from that point an elevated viaduct will run north to the present terminus of the company at Ninth and Green Streets. A branch will also be built from Willow Street out along the present line, descending to the surface near the Baltimore & Ohio junction. The capital stock of the Terminal Co. is $3,500,000, and bonds are to be issued for a like amount. The present grade-crossing at Broad Street is to be removed, but a large number of the existing surface tracks in different parts of the city will be retained to be used for freight traffic, trains being moved over them for the most part during the night. The public opposition to the plans is commented on upon our editorial pages.

A REPORT on the obstructions to the harbor at Wilmington, Del., and their remedies, has been recently submitted to a committee of the wharf owners of that city by Prof. LEWIS M. HAUPT, of the University of Pennsylvania. He recommends a dyke at the mouth of the Christian river to remedy the encroaching of the fore-shore upon the land, speaks of the obstruction of the current which will be caused by the piers of the draw bridge of the Pennsylvania, Wilmington & Baltimore Railroad, and says that the pier of the Third Street bridge should be swung round parallel to the current, as its present obliquity causes a current resistance of 300 sq. ft., and the forming of a shoal below. Prof. HAUPT says a modification of the wharf line at various points would greatly assist in improving the harbor facilities. Among other evils he notes "The absence of efficient means for preventing any and all foreign matters from entering or being dumped into the bed of the stream." and says: "The serious evils resulting from inefficient provision for sewerage and drainage can only be met by suitable municipal and legal action, whereby large 'sumps' would be provided to receive deposits, with filters and screens to arrest refuse and solids, and sewers be built to carry off animal refuse and kitchen waste. It should be made a penal offence to dump or deposit any kind of material into the bed of the stream or any of its tributaries, or to permit waste products from any manufactory to be discharged into a sewer or stream leading to the river." The report was favorably received, and will be circulated among the business men of Wilmington.

Three New Rail Joints.

That there are radical defects in the common type of fish-plate or angle-bar joints which forbid its being regarded as the permanent standard is now a matter of common knowledge and general admission. That the suspended type of joint is especially open to objection is now, we think, likewise so well settled by experience that it is no longer widely questioned, although the Pennsylvania and other lines still adhere to it, in spite of great numbers of angle-bar breakages.

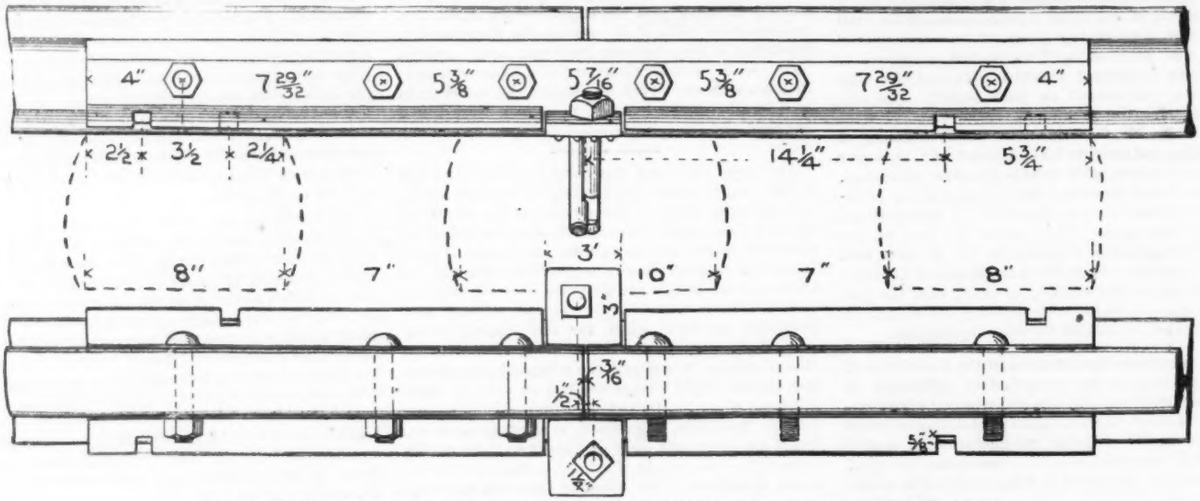
We present herewith engravings of three different efforts to do away with the defects of the angle bar without losing its supposed advantages. The first of these is the new standard rail joint of the New York Central, designed by WALTER KATTE, Chief Engineer, by whom the original three-tie joint (36-ins. long) was designed for the West Shore Railroad when it was building, and Mr. KATTE was its Chief Engineer.

We have lately had an opportunity to examine some of these joints which had been removed for the purpose after four or five years of heavy service, and we are bound to say that they were for the most part still in splendid condition. Those removed from rock ballast were in very much better condition than those from gravel ballast, but none of them showed much of that peculiar wear at the center, under the end of the bearing rail, which is so common with short fish-plates, and those from rock ballast seemed to be entirely free from it. We are informed also that not a *single one* of these joints has yet been reported as broken in service, an almost incredibly good record which we must confess taxes our belief but which at least establishes that they break very rarely, whereas the breakage of angle-bars by the thousands after short service has been a persistent and great evil with suspended 24-in. joints.

The new joint is 40 ins. long, and the angle-bars will be seen to be of a somewhat peculiar section, extending but little beyond the rail at the base and with a very heavy top section. The rail section itself we have before given. The special feature of the joint is the combination with it of the now well-known Bush interlocking bolt, the fish-plates being cut away at the center to receive the plate of the bolts. This is a feature which will seem objectionable, and we must confess that it seems a possibility to us that it will have a tendency to cause fractures, but past experience is deemed a sufficient guarantee against it, and the firm holding of the rail to the tie ought certainly to prove a great advantage. The joint is a heavy one, weighing 50 lbs. per pair.

The track is laid broken-joint with the Bush interlocking bolt opposite to, as well as at, each joint, and on curves at an intermediate tie as well. The three joint ties are spaced as shown. The intermediate ties are 8-in. face, or over. If they average less, 6 intermediate ties instead of 5 are used between the sets of joint ties. This gives joint ties 16 ins. between centers and intermediates 25⅜ ins., averaging 22½ ins.or 2,816 per mile, with 704 pairs per mile of interlocking bolts. As we lately chronicled, 64 miles of track described will be laid by the New York Central this season, and perhaps more. The Bush interlocking bolts have now been in use on the road for many years.

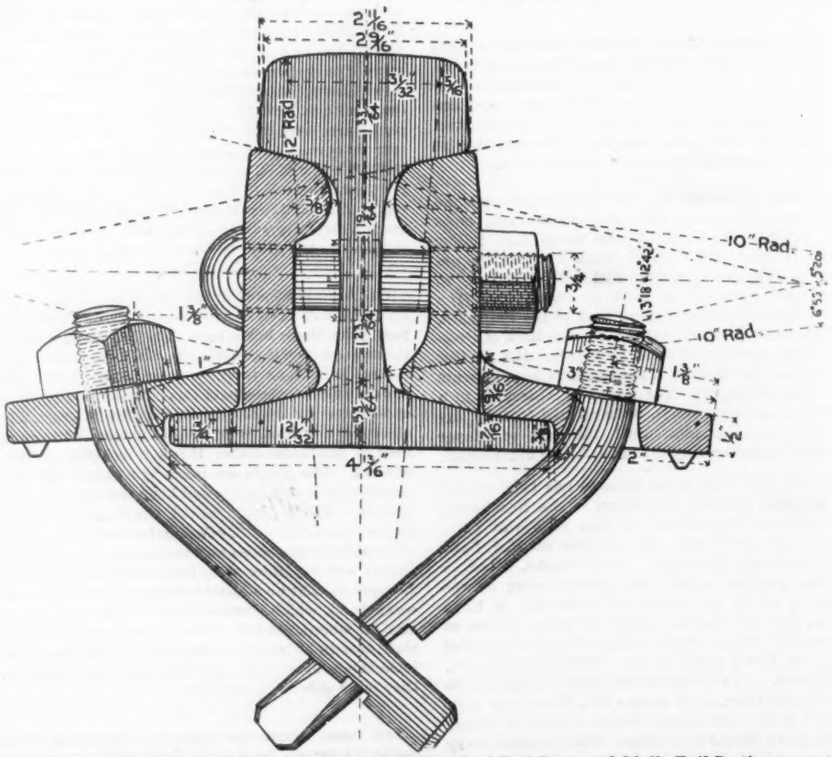
The second and third joints shown are devices of quite another character, viz., to remedy the defects of the common angle-bar joint without changing its form. Functionally they are almost identical, but mechanically they will be seen to be quite different.



The New York Central & Hudson River R. R. Standard Rail Joint. WALTER KATTE, Chief Engineer.

The first is the invention of Mr. CLARK FISHER, proprietor of the Fisher Rail Joint Works, of Trenton, N. J., and inventor of the newer features of the well-known rail joint which bears his name; the original "Fisher joint" having been the invention of his father. This joint is named the "Otis joint", after Mr. FISHER's brother, in order to avoid confusion of names only. It secures for the angle bar (as does also the third joint shown,) the very admirable feature of the Fisher joint, that it holds the two ends of the rails firmly together, so that they cannot play up and down when the wheels pass over and so rack the joint to pieces. The manner of doing this is simplicity itself, and is by means of a U-bolt and plate which, nuts and all, weighs only 3 lbs. 11 oz., but it is rather costly to manufacture and involves the necessity of punching a hole through the base of the angle-bar and nicking a corner off the rails. It is claimed, and it appears to us with reason, that this will not, practically, do any harm by weakening the angle-bar, and will cause little expense for putting the joint in. Mr. FISHER furnishes a machine by which the holes can be punched without removing the joints from the track. The U-bolt is now made with a half-oval rather than triangular section as shown.

The third joint shown is the invention of an officer of the Pennsylvania Railroad, and is now being manufactured by McConway, Torley & Co., of Pittsburg, the well-known manufacturers of the Janney coupler and of malleable iron. Its distinguishing advantage over the Otis is in dispensing with all need for cutting or punching the rails or joint, but on the other hand it is more bulky and less positive in its action. It is made of malleable iron. Whether the Otis or the Continuous joint is to be preferred we leave everyone to judge for themselves, each has something to be said for it. We are requested, however, to



The New York Central & Hudson River R R. Standard Rail Joint and 80 lb. Rail Section, WALTER KATTE., Chief Engineer.

state explicitly that the Otis joint is not offered by Mr. FISHER as a substitute for, or as the equivalent in worth, of the Fisher joint, but only as a cheaper and temporary substitute which enables old angle-bar joints to be used up. The Otis joint, in fact, was patented some years ago, but has not been put before the public by Mr. FISHER heretofore for this very reason. Recently, however, he has decided to do so.

Thomas Moore's "Epicurean" Switch-Back Railway.

There is nothing new under the sun. It is now pointed out that the "switch-back railway", which has been patronized so much of late, is an old idea, Thomas Moore, in his "Epicurean", having taken the first journey of this sort. In Chapter XI, he says:—

"At length, suddenly stopping, she (the heroine) said in a breathless whisper, 'seat thyself here'; and at the same moment led me by the hand to a sort of low car, in which, obeying her command, I lost not a moment in placing myself, while the maiden, no less promptly, took her seat by my side."

"A sudden click, like the touching of a spring, was then heard; and the car—which, as I had felt on entering it, leaned half-way over a steep descent—on being loosed from its station, shot down almost perpendicular into the darkness with a rapidity which at first nearly deprived me of breath. The wheels slid smoothly and noislessly in grooves, and the impetus which the car acquired in descending was sufficient, I perceived, to carry it up an eminence that succeeded, from the summit of which it again rushed down another declivity, even still more long and precipitious than the former. In this manner we proceeded, by alternate falls and rises, till, at length, from the last and steepest elevation, the car descended upon a level of deep sand, where, after running a few yards, it by degrees lost its motion and stopped." *Railway News*, London.

Extensions and Improvement in Open-Hearth Plant for Manufacturing Iron and Steel.

In our issue of March 24 we gave an abstract from a paper read by ALFRED E. HUNT, of Pittsburg, Pa., before the American Institute of Mining Engineers at their late Boston meeting, on "Some Modern Improvements in Open-Hearth Steel Practice." The portion of the paper from which we made our previous abstract dwelt upon "The Carbon Iron Company's Direct Process of Manufacturing Iron and Steel." We now continue our abstract by giving some account of extensions and improvements in plant for other processes of manufacturing.

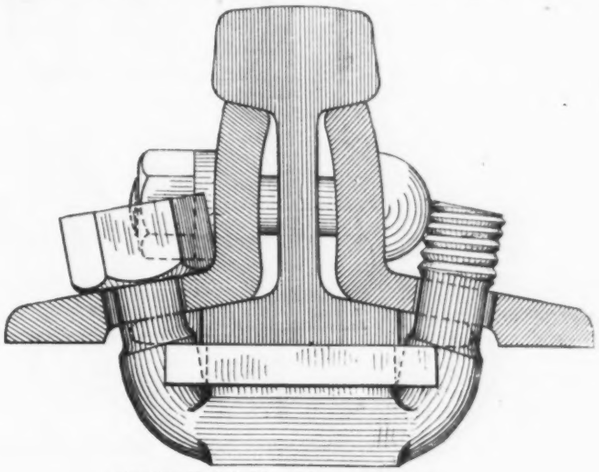
Mr. HUNT notes that some years ago it was confidently expected that the Bessemer would eventually outstrip the open-hearth process, but this has not been the case. There is, however, a very great demand for the Bessemer steel, so great, in fact, that, as Mr. HUNT mildly puts it, in the haste which is necessary to supply the demand sufficient pains are not always taken to secure the best product, and for this reason some prominent engineers are specifying other kinds of steel, exclusively. A manifest advantage of the open-hearth process is, that it admits of testing the quality of the steel during the heat by means of dipping it out in ladles, and casting in small test ingots, and it also can be handled more leisurely during the processs of rolling, which ensures a better and more uniform result. As has been explained in the issue referred to above, the direct process is also cheaper, the reoxidation being saved, and with it so much heat and labor as would be required to effect it. In 1880 there were nearly twice as many open-hearth plants as Bessemer, and while this proportion has not continued, there are now completed 50 of the former to 35 of the latter. The comparative cost of building the two kinds of works of the same producing capacities is said to be $175,000 for the open-hearth, and $300,000 for the Bessemer plant.

Of course it would be strange if there had not been great improvements in the furnaces and whole plant used for the open-hearth process. Among these improvements Mr. HUNT mentions "the incasing of the hearth in a plate iron cover, and supporting it upon iron girders running from side to side of the furnace." Before this change was made, part of the weight of the furnace and its charge rested upon the brick partition wall which separated the gas and air regenerators. The intense heat of the unencased hearth weakened the support.

Natural gas has greatly assisted in the development of this process. The gas is conducted directly to the ports of the furnace through 2 in. pipes, its flow being easily and perfectly regulated by ordinary globe gas valves. It has been found that preheating natural gas decomposes it, and so this has been abandoned. As compared with artificial gas, the loss from the lack of preheating is compensated by the fact that the natural gas is a much more concentrated fuel than the artificial. In the vicinity of Pittsburg, natural gas is admitted to the melting furnace at a pressure of 8 oz. Its steady flow gives it increased value for this process, and is a large factor in producing the excellent steel which comes from open-hearth furnaces in the natural gas districts.

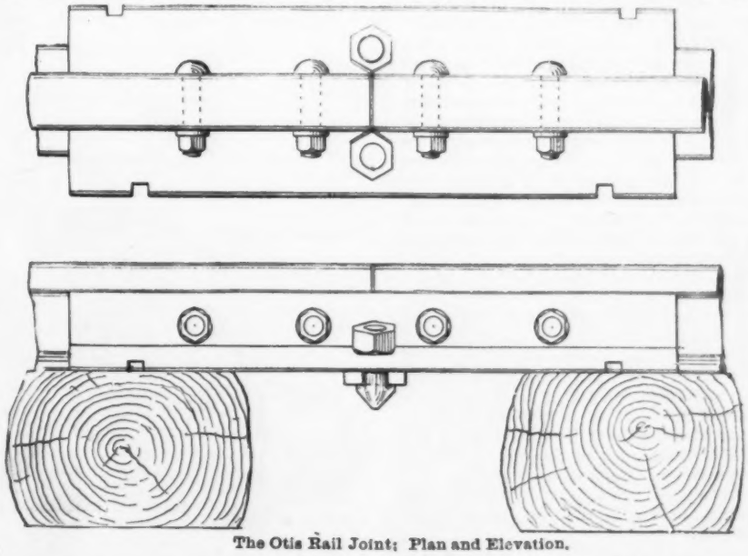
While of late the tendency has been to increase the capacity of the open-hearth furnaces, the size having risen from 5 to 40 tons capacity, it is now quite generally believed that the economical maximum size is from 15 to 20 tons capacity.

The Lash open-hearth furnace is believed by Mr. HUNT "to be the best yet devised," and while it has peculiar adaptations to natural gas, he does not see why it cannot be so modified as to work equally well with producers' gas. There are 12 of these furnaces now being erected in Pittsburg. Quitting the detailed description of the furnace, it may be said that its chief advantages are; that "the ordinary and most important operations" can be performed "around the furnace on the ground level," and that repairs can be made very rapidly. An example is given of the rebuilding from top to bottom of the lining in the chamber of a melting furnace, with a loss of but 5 days from heat to heat, and this also included the rebuilding sidewalls of the flues leading to the down-take. The Bath furnace is also described as being one of the best yet made for use in the open-hearth process. It is also easily repaired, its roof being constructed to raise up bodily and be wheeled away if occasion requires. Its linings, and the whole furnace, are especially adapted to the basic process, while it has these and other advantages over furnaces of older design.



The Otis Rail Joint; Section; Half Size.

In concluding this part of his paper, Mr. HUNT says that but little progress has been made in producing acid refractories for open-hearth furnaces. A very good silica brick has been made by one or two firms in this country, which is composed of about 97 parts of quartz, and 3 parts of ferruginous lime mixed with a milk of lime for a bond. These brick should be made by a hydraulic pressure of at least 10 tons per sq. in. It requires great care to properly mix the quartz and lime, and as this has not always been taken, some poor brick has been the result. Carefully made brick with a composition of 97.5 parts of silica, 2 parts lime, and 0.5 parts lead alumina, have been produced in this country, and they have been "fully as refractory as the best English or German silica bricks," and owing to their "more even texture and much greater strength they can be more readily cut and handled."



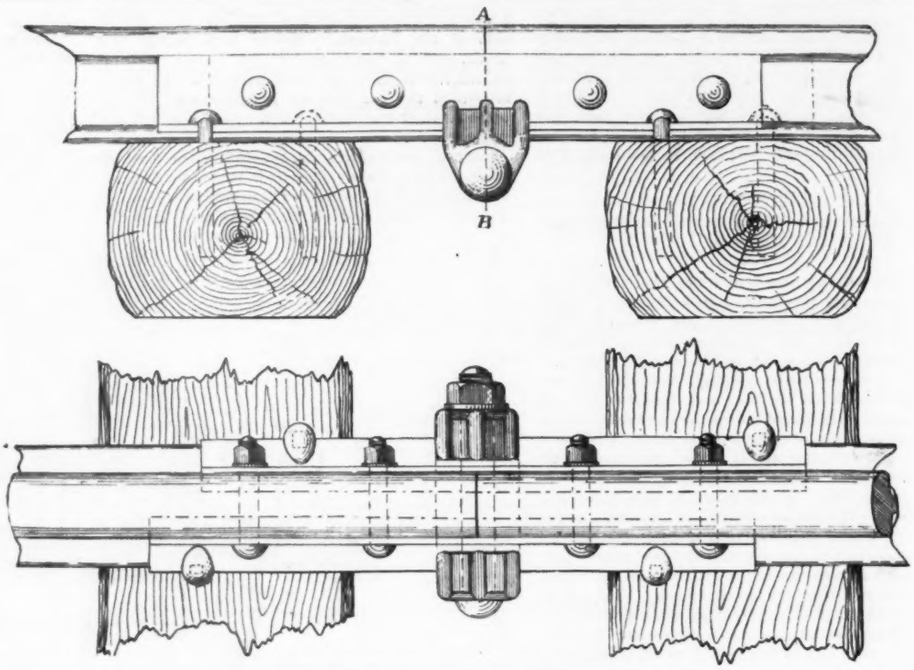
The Otis Rail Joint; Plan and Elevation.

THE Howe truss bridge of the St. Paul, Minneapolis & Manitoba Railway over the Milk river, in Montana, is reported to have been washed away, as well as several miles of track.

The Electrical Subways of New York.

To meet the demand for some systematic control over the companies owning and operating the various telegraph, telephone, and electric lighting and power lines of New York City, and to provide for such a disposition of these lines as would diminish or eliminate the danger and annoyances attending the existing method of stringing the wires on poles, overhead, through the streets and over the houses of the city, the State Legislature passed an Act in 1885, constituting a Commission of three members to be known as the "Board of Commissioners of Electrical Subways for the City of New York," to which was granted all authority and control over the companies owning and operating electric wires for any purpose, so far as related to the disposition of their wires and poles, and with special reference to their removal to underground conduits. This Board held meetings at which it heard everyone who had any wish to be heard on the general subject of subways and electric cables, and at which nearly 150 plans and models were submitted for their examination.

To show the amount of attention that had previously been given to this subject by inventors, it may be of interest to state that in 1884 a "Committee on Electrical and Mechanical Devices" of the different electrical companies, with Prof. HENRY MORTON as Chairman, had carefully examined about 600 patents and plans relating to systems of underground communications.



The Continuous Rail Joint; Plan and Elevation.

The Board also visited Chicago, Philadelphia and Brooklyn to examine the practical workings of the systems in use in those cities, and also received full reports of the subway systems in use in Washington, Boston and Detroit, and in various foreign cities. Of the various "tunnel," "driving in," "solid," "dropping in," and "combined" systems brought to their notice, the tunnel system was discarded as being too expensive; the solid system, which calls for the simple laying of insulated cables in the earth, was discarded because it would not stand the action of gases and acids, and because the streets would be continually torn up for new connections and repairs. The final decision was in favor of some system of conduits on the drawing-in-and-out plan, made of insulating material. The Commission had made a contract for the building of the subways by a construction company, and about two miles of conduit (capable of containing 2500 miles of wire) had been built on Sixth Avenue, and was in successful operation, when one of the Courts refused to recognize the legality of its proceedings, and an appeal was made by the Commission to the legislature of 1887 for an interpretation of the Act. As a result a new act was passed doing away with the "Board of Commissioners of Electrical Subways and constituting a Board of Electrical Control." The new Board was composed of the same members as the old, with the addition of the Mayor of New York as an ex officio member. Each of the Commissioners is appointed by the Governor of the State, can be removed by him for cause, and receives an annual salary of $5,000.

The state of affairs in New York City under this Act is briefly summed up in the words of the First Annual Report:

"A Commission of four members, one of them being the Mayor of the City, ex-officio, is constituted with full authority over all the electrical conductors in the city of New York, and with the special ministerial duty of changing the present overhead systems to underground systems by the providing of subways suitable for occupancy by the companies doing business at present with overhead conductors.

"A construction company (the Consolidated Telegraph and Electrical Subway Company) is authorized to construct the subways designed by the Commission and to permit the use of them by electrical companies upon fair and impartial terms.

"Over the excavations of this construction company in the streets, the local authorities, represented by the Commissioner of Public Works, have full control.

"Its profits are limited to 10 per cent. on the money actually invested by it in carrying out the directions of the Commission—the excess going to the city; and to all books and accounts the local authorities, represented by the comptroller, have access.

"A provision of law makes it incumbent upon the Board to give to companies operating conductors overhead ninety (90) days of notice for the removal of their overhead wires, after a sufficient construction of subways has been made ready in any street or locality—reference being had to the general direction of the wires in use; and in the event of the companies so notified not removing their poles and wires from the street before the expiration of the 90 days of notice, it is provided that the local authorities thereupon shall remove them.

"No corporation nor individual can place any electrical conductors, wires, or structures pertaining thereto either underground or above ground in any part of the city without the permission in writing of the Board.

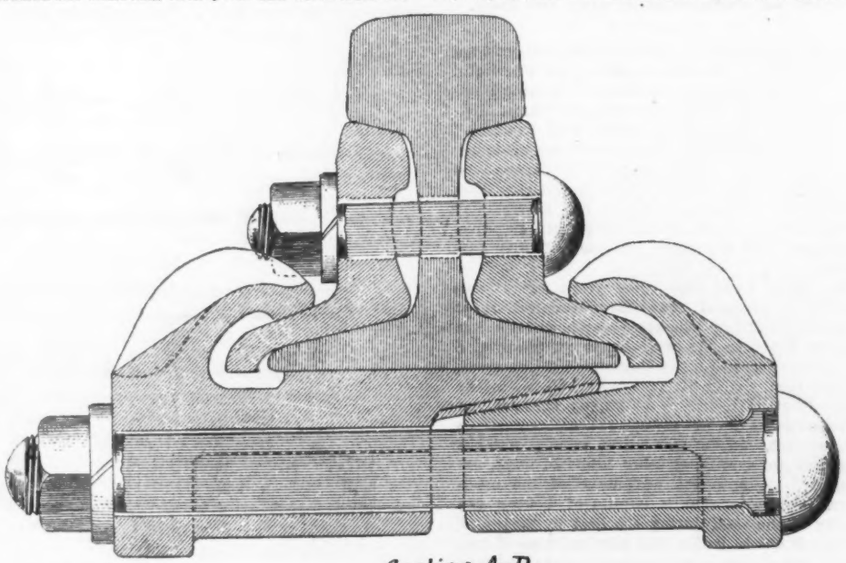
"The wires of the Police and Fire Department are not under the control of the Board, but the Board is required to provide spaces in the conduits for their wires.

"Each company using the conduits may furnish its own cables or conductors, subject to the approval and to the regulations of the Board."

These regulations may be found in its First Annual Report.

No overhead wire can be erected without a written permit from the Board. The Board has also established a series of rules and regulations for the government of overhead wires, designed to obviate some of the dangers and difficulties attending the present system. These also can be found in its report.

"All the rights, powers and duties vested in the Board of Electrical control, shall from and after Nov. 1st, 1890, be vested in the Commissioners of the Sinking Fund of the City of New York. And at any time after Jan. 1st, 1897, the said Commissioners may purchase the subways then constructed, from the Construction Company, at a price not to exceed the original cost of the structures by more than ten per cent. The purchase money for this purpose is to be raised by the sale of city bonds."

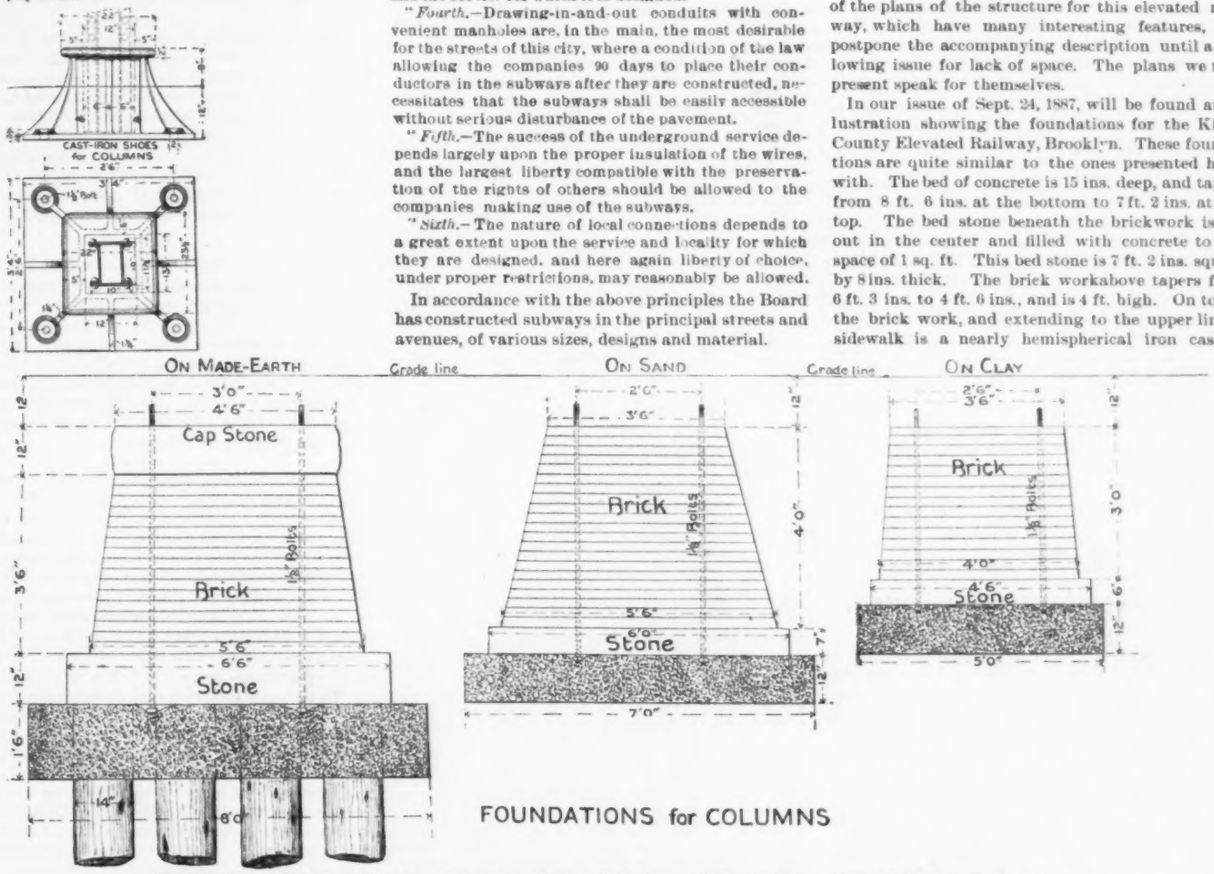


The Continuous Rail Joint; Section, Half Size.

EXPENSES OF THE BOARD.

The act provides that the salaries, and office and incidental expenses shall be paid quarterly by the Comptroller of the State; and that the amount necessary for this purpose shall be assessed by him on the several companies owning or using electrical conductors in the city. This assessment is to be based on the wire mileage of the several companies, and is to be paid into the State treasury in such install-

ments as the comptroller may require. In case any company refuses to furnish the information necessary for this purpose within twenty days, the Comptroller may form an estimate based on his best information, and assess accordingly. And in case the assessment is not paid in promptly, the comptroller is authorized to take the necessary legal steps to secure payment.



Foundation and Column Shoe, Inter-State Rapid Transit Railway of Kansas City. ROBERT GILLHAM, Engineer.

This act does not provide the means for carrying on the actual work of building subways, and in order to carry on this work the first Board (act of 1885) entered into a contract with the Consolidated Telegraph and Electrical Subway Company to furnish the funds and to do the work upon the terms already quoted. This contract was ratified and confirmed by the act of 1887, and all the work of construction is now being done by that company.

The Board has authority to remove the poles and wires from the streets on which suitable accommodation has been provided by the subways, provided the companies do not remove them within 90 days after notice; but no money has been provided by law to enable the city authorities to carry out this provision.

The method provided for paying the salaries and incidental expenses has not worked satisfactorily. In the case of some of the companies that have not paid their assessments, the comptroller has been enjoined from carrying out the legal provisions for compelling them to do so; and as the salaries cannot be paid until after the collections are made, they are very much in arrears. It is proposed to remedy this defect by an amendment to the Act which will authorize the comptroller to pay their expenses from money appropriated for the purpose as the amounts become due; these advances being paid back into the treasury as they are collected by process of law or otherwise. It will thus be seen that the design of the Act is to have the change from an overhead to an under-ground system made without expense to the State or City. In carrying out its work the Commission has followed certain principles, which it has defined as follows:

"*First.*—A conduit or subway for electrical conductor is nothing more than a mechanical protection for the wires within it, and a convenience for protecting them underground.

"*Second.*—Electric light and power conductors should as a matter of precaution, if not of necessity, be operated separately, and as far as possible from those for the transmission of currents of lesser intensity.

"*Third.*—The material and form of the subway should depend largely upon the requirements of the locality and the service for which it is designed.

"*Fourth.*—Drawing-in-and-out conduits with convenient manholes are, in the main, the most desirable for the streets of this city, where a condition of the law allowing the companies 90 days to place their conductors in the subways after they are constructed, necessitates that the subways shall be easily accessible without serious disturbance of the pavement.

"*Fifth.*—The success of the underground service depends largely upon the proper insulation of the wires, and the largest liberty compatible with the preservation of the rights of others should be allowed to the companies making use of the subways.

"*Sixth.*—The nature of local connections depends to a great extent upon the service and locality for which they are designed, and here again liberty of choice, under proper restrictions, may reasonably be allowed.

In accordance with the above principles the Board has constructed subways in the principal streets and avenues, of various sizes, designs and material.

The total length of trench excavated for the laying of subways to date is 199,658 ft.

The total construction of single duct for telephone and telegraph service is 926,560 ft.

The total construction for distributing service and connections to central stations, additional to above, 4,050 ft.

Estimating 80 wires per single duct, the total capacity for telegraph and telephone service is 74,448,800 ft. (or about 14,100 miles of wire.)

The total construction of single duct for arc lighting and power service is 254 250 ft.

Capacity of lighting and power conduit is estimated as sufficient to accommodate 2,542,500 ft. or nearly 500 miles of wire.

The total construction of conduit for incandescent lighting is 186,745 ft. containing 560,235 ft. of conductors. This makes a total, for all services, of 1,371,600 ft. or about 260 miles of single duct, and with a capacity for 77,551,535 ft. or nearly 14,690 miles of wire and conductors. The capacity of conduit thus provided by the Board is considerably greater than that of any other city in the world.

Previous to the existence of the Board the Western Union Telegraph Company had laid several miles of conduits with wires insulated with okonite or kerite. The Metropolitan Telephone and Telegraph Company had also begun to lay its wires under-ground, using the Brook's system. This system consists of an iron tube in which cotton-wrapped wires are drawn and the tube filled with oil, which acts as an insulating medium. The oil is kept at a constant pressure by means of a stand-pipe. About 215 miles of wire had been laid and put into use by this company.

It is estimated that there are between fifteen and twenty thousand miles of wire within the city limits, and that the total mileage to be provided for should be about 50,000 miles.

(TO BE CONTINUED).

Inter-State Rapid Tra-sit Railway.

We begin this week the presentation of drawings of the plans of the structure for this elevated railway, which have many interesting features, but postpone the accompanying description until a following issue for lack of space. The plans we now present speak for themselves.

In our issue of Sept. 24, 1887, will be found an illustration showing the foundations for the Kings County Elevated Railway, Brooklyn. These foundations are quite similar to the ones presented herewith. The bed of concrete is 15 ins. deep, and tapers from 8 ft. 6 ins. at the bottom to 7 ft. 2 ins. at the top. The bed stone beneath the brickwork is cut out in the center and filled with concrete to the space of 1 sq. ft. This bed stone is 7 ft. 2 ins. square by 8 ins. thick. The brick workabove tapers from 6 ft. 3 ins. to 4 ft. 6 ins., and is 4 ft. high. On top of the brick work, and extending to the upper line of sidewalk is a nearly hemispherical iron casting 21 ins. high filled with concrete, terminating in a circular plate upon which rests the foot of the post of the structure. The whole pier is firmly anchored together by iron bolts, ¾ ins. in diameter, which extend from an iron plate on top of the brickwork, down through the bed stone. It was not found necessary to place but a few of the piers of the Kings County Elevated Railway upon piles.

The foundations for the Manhattan Elevated Railway, New York, are similar to that just described, but the dimensions are smaller. The lower bed course is but 7 ft. square, and very thin. The pier above, tapers from 6 to 4 ft., and is 4 ft. high. The anchor bolts are arranged much as described above. The iron plate upon the pier is quite thick, while the posts rest upon a double pedestal, the lower one being beneath the level of the curbing, and its top being smaller than the upper base.

VERY long runs made by steam engines are considered rare, and no longer runs have heretofore been made than several days, or a few weeks. The Westinghouse engine, which has been especially designed to that end has increased this time in many instances to a number of months, the last public notice of a long run made by a Westinghouse engine being a notable instance where a certain engine ran eleven months without stopping, at a speed of 300 revolutions. A still more remarkable record, however has recently been made in the Pittsburg Gas Light Works., where a 10 H. P. Westinghouse engine has run continuously for thirteen months, running at about 500 revolutions per minute, and in that time making 233,000,000 revolutions without the throttle valve being shut, and is still running. Such a record is certainly phenomenal, and one well deserving record. We doubt if its equal is to be found in the annals of engineering.

The Weather of the United States for the Month of March, 1888.

[As respects the elements of most interest to engineers.]

According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	Temperature. Degrees Fah.				Wind Velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Heaviest in 24 hours.	No. rain days.
Northern Cities.										
Northfield, Vt.	21.6	47.9	−10	57.9	11.5	40	N	4.81	1.46	16
Portland, Me.	29.8	47.1	7.3	39.8	8.9	45	S	3.72	1.34	11
New York City.	32.0	62.9	4.8	58.1	14.1	50	NW	5.64	1.88	14
Pittsburg, Pa.	36.3	71.5	9.1	62.4	8.6	30	NW	2.51	.55	15
Chicago, Ill.	30.5	64	− 0.9	64.9	12.0	37	W	2.99	1.01	12
Omaha, Neb.	28.8	78.3	− 3.9	82.2	10.1	36	N	3.25	1.05	10
St. Paul, Minn.	18.2	42	−13.7	55.7	8.3	36	NW	1.11	.36	9
Duluth, Minn.	15.4	45	−13.5	58.5	8.7	40	NE	.81	.35	12
Bismarck, Dak.	13.4	46.8	−20.4	67.2	11.2	50	NW	.87	.52	11
Average.	25.1	56.2	−4.6	60.7	10.4	41		2.86	0.95	12
Southern Cities.										
Washington City.	37.0	76	10	66.0	9.0	42	NW	4.53	1.65	12
Louisville, Ky.	43.6	73.5	13.8	59.7	9.8	36	W	5.71	1.24	9
St. Louis, Mo.	40.8	76.0	14.0	62.0	12.2	48	W	3.79	1.62	11
Savannah, Ga.	56.4	78.5	32	46.5	8.3	36	NW	2.24	.86	7
Leavenworth, Kan.	37.0	78.5	10.8	67.7	8.5	28	S	4.55	1.59	11
Jacksonville, Fla.	60.3	83.5	35.0	−48.5	6.7	29	S	1.57	.80	6
Chattanooga, Tenn.	49.3	80.5	22.4	−58.1	8.1	42	W	6.86	3.29	12
New Orleans, La.	60.3	78.0	40.7	37.3	9.2	33	S	6.45	2.02	13
Memphis, Tenn.	49.4	80	28	52.0	8.2	36	NW	5.40	1.89	16
Palestine, Tex.	53.3	78.8	29 3	49.5	10.1	33	W	9.48	4.72	10
Average.	48.7	78.3	23.6	54.7	9.0	36		5.06	1.97	12
Western Cities.										
Helena, Mont.	23	64	−13	77.0	6.3	36	NW & SW	1.32	.52	15
Fort Angeles, W. T.	Report not received									
San Francisco, Cal.	52.5	73.7	38	35.7	8.2	36	SE	3.61	1.34	11
Salt Lake City, U.	40.4	68.5	19	49.5	6.4	36	NE	2.18	.60	10
Denver, Col.	33.5	70	− 1.5	71.5	4.4	36	NE	1.15	.52	12
Yuma, Ariz.	62.5	86.8	37	49.8	7.6	46	S	.05	.05	1
Santa Fe, N. M.	37.4	64.3	14	50.3	6.2	30	SW	.61	.23	12
Average.	41.6	71.2	15.6	55.6	6.5	37		1.48	0.54	10

The Defective Assembly Chamber Ceiling.

The German Technical Society of New York has published the following resolution regarding the unsafe large groined vault in the Assembly Chamber of the new capitol at Albany, N. Y., supporting the views expressed by Mr. FABIAN some years before the actual failure of the ceiling, Mr. FABIAN, we apprehend, correctly diagnosed the difficulty in advance and is entitled to great technical credit for doing so.

Whereas the German Technical Society of New York, after a careful examination of treatise published by its Corresponding Secretary, H. W. FABIAN, in the "American Architect and Building News" (October 29, 1881, and March 29, 1884), has been convinced that the dangerous condition of the large groined vault of the Assembly Chamber of the new capital at Albany was justly and correctly criticised by him already some years ago, and

Whereas a development of the monumental building art, keeping pace with modern technical researches should be striven for,

Be it Resolved that we indorse the following summary of Mr. FABIAN's statements as fully corresponding with the facts, and submit the same to the public:

1. The main cause of the instability of the vault is based upon the form of the inner construction, the lines of pressure in the bearing ribs considerably deviating from the middle lines. Hence follows an exceeding unequal straining of material in the dangerous cross sections and the existence in the outer fibres of strains of pressure considerably exceeding the allowable maximum. The resultant of the normal forces in the weakest cross sections acting considerably outside of the central core, tensile strains are produced, which involve the cause of enormous deformation. These facts are sufficient to fully explain the endangered stability of the vault.

2. The construction of flying buttresses, joined together by iron tie-rods in order to gain the balancing power between the horizontal thrusts of the smaller and larger arches, is not in accordance with the demands of sound vault architecture. Two arches will be in equilibrium if in both the product of the radius of curvature multiplied by the height of load both taken in the summit is equal. According to this law the problem might have been solved without employing flying half-arches and tie-rods. This manner of construction is objectionable on account of the unequal expansion of iron and stone; every change in temperature will cause a vibration in the arch system, which vibrations in the course of time imperil the stability of the vault. It is not believed, however, that the essential causes of the present deformation are to be sought in this direction.

3. Nor can the stated unequal settling of the columns be seriously considered in judging of the deformation, it being in comparison insignificant with the great dimensions of the vault. Both faults, this as well as the beforenamed, might indeed contribute to the aggravation of the defective condition, but not of themselves cause of it.

4. The attempt of the architect to ceil the Assembly Chamber with a monumental stone construction can be but approved. The art of vault building, as it has come to us from the middle ages is, however, constructively impotent to cover areas of this size. The ceiling of our large modern halls with stone vaults can, therefore, only be attained, when in place of the historical vault-lines, there are employed mathematically developed arch-lines, which coincide with the lines of pressure. Then the material in all its parts would *be strained quite uniformly* and only influenced by pressure. The additional load as employed at Albany to improve the lines of pressure in the pointed arches could then be dispensed with, and thus the total load be considerably decreased. There is no doubt that a groined vault built on such principles of construction can be employed for the Assembly Chamber at the Albany Capitol, without fears as to its stability.

In the interest of progress in monumental architecture, which is indissolubly connected with the employment of stone as a building material, it is, therefore, to be desired that the Legislature should adopt a resolution to that end.

The adaptability of the old material in case of reconstruction of the vault undoubtedly deserves some consideration in the light of the foregoing.

The Committee, { ROBERT STRIKER, AUGUSTUS KUETH, MAX C. BUDELL, F. KNAUER, E. A. GIESELER.

We entirely agree with the view here expressed that it is desirable, if possible, to preserve the original form of ceiling with its defects of proportion corrected. The building has cost too much to have anything out of keeping with its general magnificence introduced unnecessarily.

ENGINEERING NEWS.

RECENT experiments in Russia to ascertain the relative cost of oil, gas and electricity show that at St. Petersburg gas costs 3 times as much as oil, and electricity 7.3 times as much, while lighting by stearine candles is 22.9 more costly than by oil. At Moscow there was a general increase in cost, the figures being: gas, 6.2 times, electricity, 10.4 times, and the stearine candle 34.4 times greater than oil.

THE Standard Oil Company, it is stated, has completed arrangements for building a pipe line from Lima, O., to Chicago, a distance of 210 miles. It is said that right of way has been secured along the line of the Chicago & Atlantic Railway, and that pipe for the line is now being delivered, and will be laid as soon as the weather will permit. The pipe is said to be of wrought-iron, 8-ins. in diameter and in sections 22 ft. long. The joints are to be perfectly tight, and will be similar to a gas-pipe joint. The material and labor for the pipe line alone are estimated to cost $7,000 a mile, and the whole system with pumps, buildings and various accessories, $3,250,000.

THE displacement of from 10 to 12 ft. of sand on the sea coast of Brittany, at a place called Port Blanc, has revealed a coal bed in the process of formation. At this point the sea has been encroaching since the time of the Roman Conquest, and the ancient forest of Scilly has gradually been submerged, and its site transformed to a coal bed. The transformation is now beyond the peat stage, and the action of the sea has afforded an excellent chance for geologists to study a very important phase of the earth's formation.

A COMMISSION has been appointed by the United States Navy Department to conduct tests of a new high speed compound engine adapted to marine or stationary use, recently perfected by the Jonson Foundry & Machine Company of this city. The tests are now in progress at the works of the company at 118th St. and Harlem river, and will continue about a month. The Members of the Commission are Chief Engineer W. W. DUNGAN, CHAS. E. ROMMEL and A. B. CANAGA.

THE Niagara River Hydraulic Tunnel, Power, and Sewer Company, incorporated March, 1886, claims to have secured capital to put through their project. It is now stated that construction will begin in July. In a prospectus just issued the company proposes to construct a subterranean tunnel from the water level below the falls, about 200 ft. under the high bank of the river, extending through the rock to the Upper Niagara river at a point about one mile above the falls, where a head of 120 ft. is obtained. The tunnel is then to extend, parallel with the shore of the river, one and one-half miles at an average depth of 100 ft. below the surface of the earth and at a distance of about 400 ft. from the navigable water of the river with which it is to be connected by means of conduits or lateral tunnels. These conduits will lead to wells 100 ft. deep, sunk to the tunnel, and in which will be placed turbine wheels, all as outlined in our discussion of the matter in our issue of Nov. 19, 1887. The water in the river, will only be diminished in volume 1 per cent., or in depth an inch or so.

THE prospectus states that since incorporation, sufficient land has been secured, surveyed, and laid out along the river and tunnel to accomodate 238 mills of 500 horse power each, or a total of 119,000 horse power. This is most erroneously stated to be "a greater amount of horse power than is utilized in all the rest of the country combined."

We trust the statements of the rest of the report rest on a more solid basis of fact than this, since, according to the returns of the Tenth Census there were, even in 1880, 55,404 water wheels giving a total power of 1,225,379 horse power or 35.93 per cent. of the total power of all kinds used.

The land secured is 2½ miles above the Falls, and beyond the limits of the Government Park land surrounding them. The tunnel is to run under the streets of Niagara village, and all of the conduits will be located on the company's land. The estimated cost of construction is $3,000,000, and enough patronage has already been secured, it is said, to pay a dividend on the investment. The city of Buffalo has agreed to pay $100,000 per annum for power for electric lights, and an electric smelting company in Cleveland has made application for 20,000 horse power to be carried through wires. The mills are to be located so far above the falls that vessels of any draught can come to the wharves, thus insuring cheap water freights from the mills to tide water. If the project, as outlined, proves successful, power for electric lighting and manufacturing will be distributed by means of electric wires to other cities in the vicinity.

THE *Medical Summary* alleges that the best way to get a cinder out of the eye, is to let it alone and simply rub the other eye. An almost equally effective remedy, is to catch hold of the eyelid of the affected eye, and pull it forward and downward over the lower eyelid. This seldom fails to relieve the eye, if done in time.

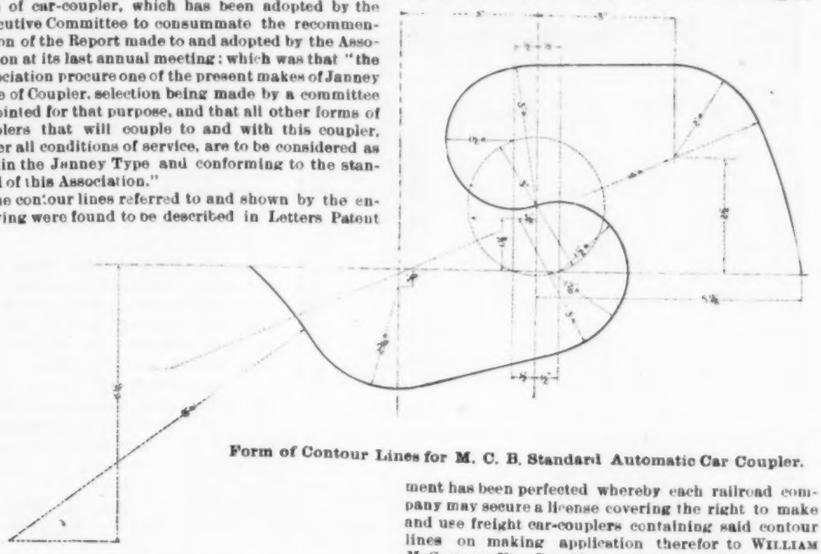
The Standard Car Coupler.

The Executive Committee of the Master Car-Builders' Association has made the following announcement of the recently adopted form of contour lines for the M. C. B. Standard Automatic Car-Coupler as shown in the accompanying engravings:

An engraving is sent herewith which shows the form of contour lines for the Master Car-Builders' standard type of car-coupler, which has been adopted by the Executive Committee to consummate the recommendation of the Report made to and adopted by the Association at its last annual meeting: which was that "the Association procure one of the present makes of Janney Type of Coupler, selection being made by a committee appointed for that purpose, and that all other forms of couplers that will couple to and with this coupler, under all conditions of service, are to be considered as within the Janney Type and conforming to the standard of this Association."

The contour lines referred to and shown by the engraving were found to be described in Letters Patent No. 212,703 granted to ELI H. JANNEY, February 25, 1879, and to be covered by the 8th and 9th claims thereof.

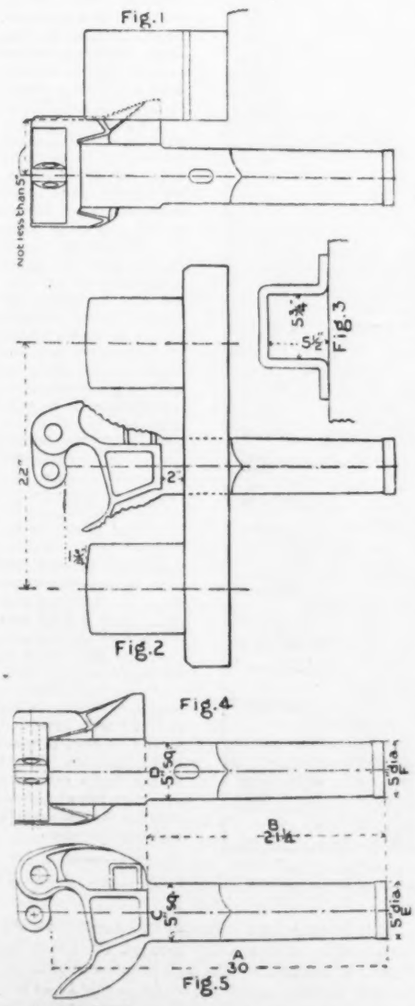
The owners of said patent, in consideration of the adoption of the Janney type of coupler as the Master Car-Builders' standard type of freight car coupler, have agreed to waive their rights secured by said 8th and 9th claims, in favor of all railroad companies members of this Association and the Eastern and Western Railroad Associations, which may decide to adopt the Master Car-Builders' type as their standard; and an agreement has been perfected whereby each railroad company may secure a license covering the right to make and use freight car-couplers containing said contour lines on making application therefor to WILLIAM MCCONWAY, Vice-President of the Janney Hein Coupler Company, Pittsburgh, Pa.



Form of Contour Lines for M. C. B. Standard Automatic Car Coupler.

In making this concession it will be understood that the owners of said patent do not thereby license or convey any right secured to them by the other claims of said patent or by any other patents owned or controlled by them.

In order to secure uniformity in the dimensions of the stem dead-blocks and carrier irons and proper protection for the Master Car-Builders' type of coupler, the Executive Committee recommended the dimensions given in the accompanying engravings (Figs. 1, 2, 3, 4 and 5). The Committee are of the opinion that double dead-blocks or bumpers should invariably be used with this type of coupler. The contour lines are now the standards of the Association, and it is the purpose of the Executive Committee to submit its recommendations with reference to the dimensions of stem, etc., and the use of dead-blocks, for adoption as standards at the next convention of the Association.



Recommended Dimensions for Master Car-Builders' Standard Car-Coupler.

Appliances for the Safety of Trainmen.

The Committee on Standards and Appliances for the Safety of Trainmen, of the Master Car-Builders' Association, has issued the following circular of inquiry as to the subject in their charge:

The Railroad Commissioners of the State of New York report that during the year ending Sept. 30, 1887, there were 199 railroad employés killed and 896 more or less severely injured, in the performance of their duties. These accidents are classified as follows:

	Killed.	Inju'd.
Fell from train, engine or cars, or getting on or off trains,	48	152
Striking low bridges, switches, tunnels, etc.	8	9
Coupling or uncoupling cars,	20	437
Walking or being on track,	102	88
Catching foot in frog or between rails,	4	7
Derailment,	1	19
Collisions,	6	40
Other causes,	10	144
	199	896

According to Poor's Manual the number of locomotives owned by railroads in the State of New York in 1886 was 2,732, and in the whole country 26,415. It will be quite safe to say that there were ten times as many locomotives in the whole country as there were in New York State during the period covered by the Railroad Commissioners' report. If the average number of persons killed and injured per locomotive is the same elsewhere, the number of casualties to railroad employés in the whole country would be ten times the above figures, or total in round numbers of 2,000 killed and 9,000 injured.

No pretense is made that this estimate gives the number of employés killed and injured with anything more than approximation to accuracy. It must be remembered, though, that whatever errors there may be in the reports to the Railroad Commissioners, of accidents and of the number of locomotives in the country, are errors of omission, and that probably both the number of accidents and of locomotives are greater than reported, which would make the above estimate too low rather than too high. Nevertheless, with any reasonable deduction the record of frightful suffering, pain and sorrow will be more than sufficient to emphasize the following enquiries, the aim of which is to elicit information that will indicate how the number of such accidents may be diminished.

All railroad officers and employés, whether members of the Master Car-Builders' Association or not, are therefore requested to answer the following questions:

1. What defects are there in the present construction of cars and locomotives which cause accidents to railroad employés by falling from trains, engines or cars, or of accidents in getting on or off trains?
2. What changes could be made in cars or locomotives which would diminish the number of such accidents?
3. What kinds of couplers and dead-blocks are the most dangerous to employés in coupling cars?
4. What kind of coupler and dead blocks do you think is the least dangerous to employés?
5. Has the introduction of automatic couplers thus far lessened the danger of coupling cars?
6. Would the general introduction of automatic couplers in your opinion, diminish the danger of coupling cars?
7. Can you suggest any way of lessening the number of accidents to employés from "walking or being on the track?"
8. How can employés be prevented from "catching their feet in frogs or between rails?"
9. In what way may any other kinds of accidents to employés be prevented or the number lessened?

All railroad officers and employés, who see this circular, are earnestly solicited to answer it, and thus add the weight to their testimony in helping to reduce the terrible sacrifice of life and limb which is annually exacted from our railroad employés.

JOHN KIRBY, M. N. FORNEY, } Committee.

Most of these questions have been asked and answered over and over again in successive years with no great progress to show as a result, and some of them, as notably the sixth, seem somewhat superfluous, but it is satisfactory to see that agitation of the matter continues. A singular omission is all inquiry as to the introduction of freight train brakes, which would abolish accidents due to falling from train and striking low bridges, almost completely, and greatly diminish the frequency of all the others, so that fully half of the above list should be saved by that improvement alone, and in connection with automatic couplers more than half of those killed, and fully three-quarters of those injured. There is now no further excuse for delaying in the matter of brakes and couplers because of doubt as to the proper devices to adopt, and therefore the continued sending out of queries as to whether it is worth while to adopt them anyway, seems a little absurd.

A Swedish Road Locomotive.

From the *Teknisk Tidskrift* we get the following interesting account of a road locomotive which has been used, and operated successfully, at an investment of about $2,500, whereas a railroad for the same stretch would have cost about $35,000. The driving wheels are nearly 16 ins. in width. Two or three wagons with a capacity of 8 tons, are drawn by the engine. The wagon wheels are 8 ins. in width. The stretch of road upon which it runs is 3.6 miles long, and has grades ranging up to 9 per cent. The engine hauls about 17 tons, and has transported annually about 8,000 tons. The speed ranges from 2½ to 3 miles per hour, at a coal consumption of 1.44 to 2.65 litre for the ton kilometer, 1 litre per ton-kilo. being equal to about 2.83 lbs. per ton-mile.

A man and a boy run the train. The cost of maintenance per ton per mile is 2½ cts. in summer, and 5 cts. in the winter. The road surface has been greatly improved both as to solidity and evenness. During the 16 months in which it has been used by the locomotive, no accidents to the train, nor by frightening horses have been reported.

While this, of course, is much more costly haulage than on a railway with considerable traffic, it is an instructive example of the successful use of road locomotives for an ordinary country road traffic with a very large economy over haulage by animal power.

Experimental Tests for Foundations.

In connection with the buildings for the forthcoming Paris Exhibition, a series of experiments have recently been carried out at the Champs de Mars, with a view to determine the resistance of the soil to concentrated loads, and in this way check the dimensions to be given to the foundations in different cases. The results are thus summarized by *Engineering*:

"A perfectly level surface in the form of a square of 118 ft. side was first prepared on which were placed four rectangular cast-iron blocks 1 ft. 8 in. square, disposed so as to occupy the corners of a square, the distance apart being 11 ft. 8 in. center to center, and these spaces were bridged by girders constructed of T irons. These girders were now loaded with T irons, the number and weight of which were carefully noted. At the end of eleven hours the weight on the girders had reached a total of 143,923 lbs. and indications of settlement became visible, the stress on the surface of the ground being at this moment 7,311 tons per sq. ft., in which is included the weight of the blocks and girders in addition to the above load. The experiment was then abandoned till the following day, when it was found that the settlement had increased during the night to an amount varying between 10¼ in. and 11 in. The experiment was now resumed and the load increased up to 209,776 lbs., at which the experiment was abandoned, as some of the blocks had then sunk completely out of sight, leaving the girders to be supported directly on the surface of the soil. The conclusions arrived at were that the ground at this spot is capable of resisting a load equivalent to 5.43 tons per sq. ft, that a certain amount of settlement may be expected when the stress reaches 7.31 tons per sq. ft., and that it is totally incapable of bearing a load amounting to 8.14 tons per sq. ft."

Rapid Transit in Cities.

An interesting lecture on this subject was recently delivered before the Franklin Institute by Prof. LOUIS M. HAUPT and has since been reprinted from the *Journal of the Franklin Institute*. Prof. HAUPT emphasized the fact that for the prosperous development of a large city rapid transit is a necessity, and in discussing the comparative advantages of elevated and subterranean systems admits that those of the latter may be greater. The cost of the two systems is discussed, and various figures are given in illustration, beginning with the following estimates by Mr. JNO. J. DEERY, C. E., of the cost of the Metropolitan Underground Railway of Philadelphia:

Estimated Expenses (per mile) for a Four-Track Subway, Sixty Feet Wide in Philadelphia.

Earth Excavation,	$124,893
Masonry in cement,	110,100
Concrete (1:1),	160,380
Bricks, including laying in cement,	103,660
Shoring,	30,000
I-beams,	135,327
Plates and bolts,	6,358
Sixty-pound steel rails, angles, etc.,	44,136
Ties	2,640
Dressed stone masonry,	24,288
Asphalt,	32,314
Sewers,	22,000
Repaving with Belgian blocks of asphaltum,	34,547
Sidewalks,	10,558
Electric equipment, locomotive, cars, etc.,	122,000
Contingencies and engineering expenses, etc.,	96,350
Average cost per mile of covered subway,	$1,059,851
For the open-cut work, the estimated cost is	$580,774.70

In comparison, the nominal "cost", as represented by stock and bonds, of the Metropolitan Elevated Railway of New York, is quoted from *Poor's Manual* for 1886, at $1,055,000 per mile.

Looking abroad, Prof. HAUPT gives some figures concerning the Berlin Metropolitan line, which was built by the government, and was an elevated masonry arcade. The length of the line was 7.5 miles, and the cost per mile, $2,115,000, nearly half of which or $862,000 per mile was paid for property, indicating clearly that the saving in right of way for an underground line must be an important item if right of way is bought for an elevated system.

Prof. HAUPT continues:

"As a further check upon the estimate already submitted for the proposed Metropolitan Underground Road, I have looked up the cost of structures already built under nearly the same conditions, and find that the Union Tunnel, built in 1871-73, by the Pennsylvania Railroad Company, under the city of Baltimore, cost $247 per lin. ft, or $1,304,160 per mile. The material was clay, sand and rock. The dimensions were those generally used for double track, viz., 26 ft. in width and 19½ in height. The excavation was let at $5 per cu. yd. and the masonry lining at $9 to $9.50. The total length was 3,402 ft. and aggregate cost $840,000.

"In the case of the underground road, in New York, known as the Fourth Avenue Improvement, provision is made for four tracks, two for express and two for way trains.

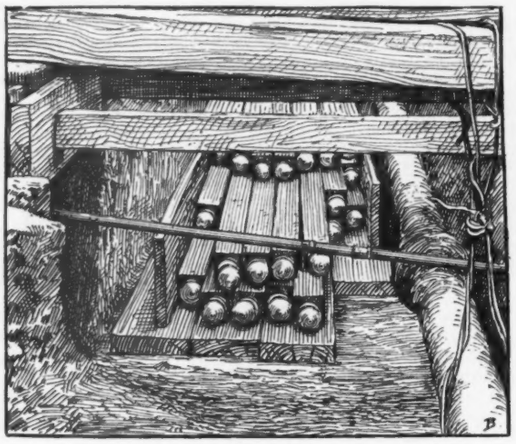
"The work was authorized May 14, 1872, and the expense was to be divided equally between the city and the Harlem Railroad Company. To this end the city was empowered to raise the money by a special tax on real and personal property. The contract was executed and work was commenced late in the fall of the same year, with the firm of Dillon, Clyde & Co., for the sum of $6,395,070, for the four and one-half miles, or $285 per lin. ft.

"Of the entire distance from Forty-second to One-hundred-and-Thirty-third St. one section of 6,937½ ft., is open cut; one of 4,562½ ft. is viaduct, and the remainder, 10,662 ft. tunnelling, or covered way. At the rate of $285 per ft. it would make the cost $1,504,800 per mile. This is for a section 76 ft. wide in some places, and in which no provision is made for municipal service, and I believe I am correct in saying that no revenue is paid to the city, whereas the section proposed for the underground road here is but 48½ ft. for the four-track roadway, or about 60 ft. including the subways, and but 24 ft. for the two-track roadway, or 32 to 34 ft. including subways.

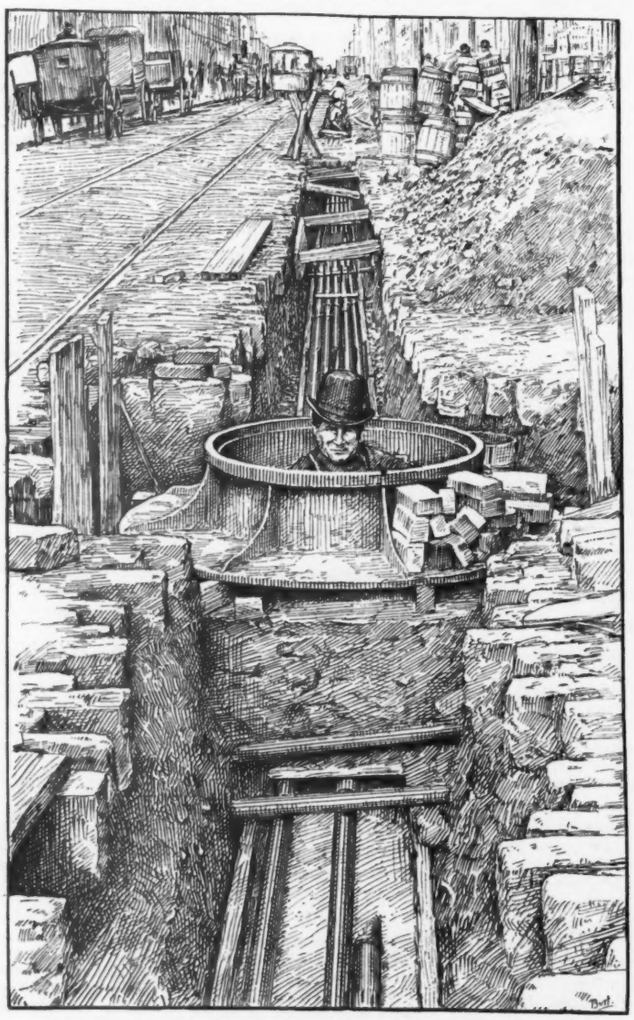
In Philadelphia, it is stated that the cost of the Pennsylvania Railroad Company's elevated tracks along Filbert St., was $266 per lin. ft., or $1,404,480 per mile, for a nine-track brick arcade, 108 ft. in width.

In concluding his lecture, Prof. HAUPT's remarks have especial reference to Philadelphia, but they are equally applicable to all large cities.

"Every person brought into a community requires an average of 435 sq. ft. for his healthful existence. This is at the rate of 100 individuals, or say 20 families to the acre. Deducting 30 per cent. for streets, it would give a lot of a size 18 × 87½ ft., per family, which is certainly small enough. If the increase in population be taken at the rate of 5 per cent., we should have about 50,000 additional citizens a year, now about 20,000, or 10,000 families requiring 517 acres, or nearly a square mile per year for the immediate future. Unless such an area is provided, a positive injury is imposed upon the individual as well as the community, and as there is no such available room within the already too densely settled built-up limits, the new comers are obliged to find a habitat on the outskirts, and are subjected to the heavy indirect taxes resulting from loss of time and cost of transportation. This loss of time may soon reach a large percentage of the working day, and will prove in the future a greater barrier to growth than it has in the past, unless the city will provide a means of transit more rapid than the jog-trot of the horse cars, and over a surface of less resistance than one paved with cobble-stones."



Creosoted Wood Conduit at Sixth Ave. near 11th St.



Cement-lined Sheet Iron Conduit at Greene St. near Spring St.

THE ELECTRICAL SUBWAYS OF NEW YORK CITY.

A NEW boat, called "The Ice Crusher," has lately been used in cutting a way through the ice in the Straits of Mackinaw. The boat has an arrangement in front for cutting the ice, which is said to be like a rotary plow, and has made its way through ice which was 31 ins. thick, and nearly as solid as in January.

CORRESPONDENCE.

A Formula for Vertical Curves.

GALVESTON, Tex., April 4, 1888.

EDITOR ENGINEERING NEWS:

I hand you a formula for vertical curves that I have used, and do not know of its being used by anyone else:

Let R and R' = profile grade rates per cent.

" r = assumed change in rate of curve grade per cent.

Let T = distance each way, in stations from intersection of profile grades to tangent points.

Let b = profile elevation of origin.

" x = abscissas in stations.

" y = ordinates in feet vertical.

The general equation of the curve is,

$$(1) \qquad y = r\frac{x^2 - x}{2} + b$$

If $x = 0$ $y = 0$
" $x = 1$ $y = 0$
" $x = 2$ $y = 1\,r + b$
" $x = 3$ $y = 3\,r + b$

$$(2) \qquad T = \frac{\frac{R \mathbin{\text{x}} R'}{r} + 1}{2}$$

x being algebraic difference between, with + sign.

To use, assume r and find T, then starting from either tangent point, produce that grade line past the vertex for the same number of stations, and note elevation of each station.

Then subtract (at summits) or add (in depressions) from or to the elevation found at each station, as follows:

At tangent point		0 r
1st station on curve		0 r
2d	"	1 r
3d	"	3 r
4th	"	6 r
5th	"	10 r
6th	"	15 r
7th	"	21 r
8th	"	28 r
9th	"	36 r

Example. $R = +2.0$ $R' = -0.8$ $r = 0.4$

$$T = \frac{\frac{2.8}{0.4} + 1}{2} = 4.$$

Call station at vertex 100; then the tangent point on + 2.0 grade will be at station 96; call this elevation (or b) 50.0. Produce this grade line and the profile elevation will be successively from station 96 to station 104, both inclusive. 50.0, 52.0, 54.0, 56.0, 58.0, 60.0, 62,0, 64.0, 66.0.

Beginning at station 96, subtract from each as follows: 0.0, 0.0, 0.4, 1.2, 2.4, 4.0, 6.0, 8.4, 11.2, and the curve elevations of each station are 50.0, 52.0, 53.6. 54.8, 55.6, 56.0. 56.0, 55.6, 54.8.

It will be seen that the first and last stations in curve coincide with the profile grades. C.

A Suggested Bridge Guard.

DONALD, B. C., March 31, 1888.

EDITOR ENGINEERING NEWS:

I have read with great interest the various articles on Bridge Guard Rails which have appeared from time to time in your valuable journal.

On examination of the cut showing system adopted by the N. Y., Ontario & Western Railway Co., in your issue of Jan. 28, 1888, I find it possible for a truck off the track, if partly slewed, to take the wrong side of the point in center of track before coming in contact with the outer guard rail. This of course can be remedied by changing the relative positions of the point and the flare in the outer guard rails. I also notice that the outer guard rails are 6×8-in., and boxed 1¾-in. leaving only 4¼-in. above the ties. This I consider altogether too little. A car wheel coming against this guard would cut into and mount it, especially if of soft pine and not protected with angle-iron. A wooden outer guard rail should be at least 8-in. above the ties to have any effect on a derailed truck. The ties shown are too short; bridge ties should not be less than 8×8-in. and 14 ft. long.

With regard to the inner guard rail I consider this to be a very dangerous plan to adopt on our Northern railways on account of ice forming between the guard and track rails. There would also be danger of brake shoes, bolts and other detached portions of car gear falling into this space. It is beyond doubt that an inner guard rail will be more effective than an outer one, for the reason that the wheels of a truck coming in contact with the inside guard rails will be retarded, this tending to turn the truck back on the track again, or at least parallel to the track. But in the case of an outside guard rail the effect is the opposite, the tendency being to turn the truck further out of line, owing to the wheels binding on the side of the guard rail, and slewing the truck around, but it appears impossible to get inside guard rails without some serious objection, as I have endeavored to show in regard to the plan above referred to.

I consider the collision posts very commendable features, as it is evident that a car far enough off the track to strike the collision posts, if allowed to proceed, would strike the end post of the bridge. the damage to the train would be the same in either case, and if stopped by the collision posts the bridge may be saved.

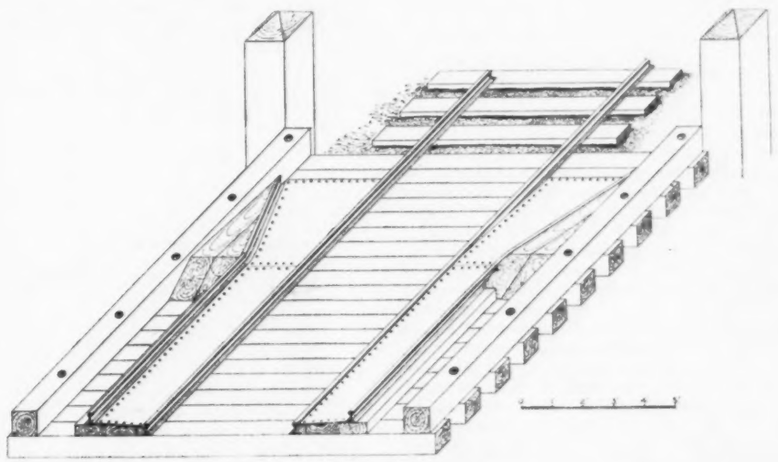
I have pointed out what I consider the defects in a system which you endorse as the best in use—and I am not prepared to dispute your opinion. The best system in use, so far as I have knowledge of it, is to my mind poor indeed, and capable of much improvement. For the purpose of having this question more fully discussed I submit to your readers (if you will kindly allow the space), a sketch of a proposed bridge guard. The principle of this system is to present as little resistance as possible to wheels which may be off the track on the outside of the rail, while allowing the wheels which are between the rails to bump along on the ties, thus tending to right the truck or turn it toward the track again. This principle I have frequently noticed employed in putting a car on the track when derailed, by simply placing a plank under the outer wheels and pulling the car along, the inner wheels riding the ties. The truck would by this means be brought close enough to the rail to allow the regular rerailing frogs to be used.

As will be seen by referring to the sketch, there is a timber floor covered with boiler plate on the outside of each track rail, the whole of the height of the rail, and also a rail to act as a guard rail; and outside of this again is a wooden guard rail 10 ins. above the ties. Rerailing frogs (not shown in sketch) may be placed on the inside of each track rail at various places along the bridge.

I trust your readers will point out any defects they may see in it, as I have no doubt it can be greatly improved.

I shall be pleased to have the subject of bridge guards more fully discussed, so as in the end to give to the public a better system of bridge guards than any now in use. Yours very truly,

R. BALFOUR.



A Suggested Bridge Guard.

The Bad Economy of Small Pins.

COLUMBUS, O., April 6, 1888.

EDITOR ENGINEERING NEWS:

Having watched the discussion of bending in pins with considerable interest, I am glad to note that the present bridge practice of figuring moments from strains considered as concentrated at the centers of the members, probably always errs on the safe side. Also that it does not err in ordinary cases to an extent which will warrant us, from economic reasons, in indulging in any hair splitting theories which will lead us into the region of doubt.

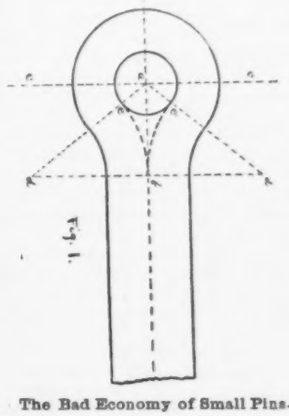
This is not intended as discussion as you have already declared that "off"; but merely to call the attention of bridge designers to the small saving which will usually be effected by the use of the somewhat startling fibre strain of 100,000 lbs. per sq. in., or thereabouts. Also to the danger of unequal loading on different bars, and of destructive flexure in the bars themselves.

I must, however, beg leave to differ with Mr. STOWELL in his conception of the strains which take place in a bar head, as expressed in his article on page 240 of present volume.

In the first place, he assumes that all the pressure between the eye and pin is concentrated at one point, and that point is the center of the half-cylinder surface over which the strain is really more or less equally distributed. Or what else are we to understand from his formula,

$$\frac{s}{2}\,\frac{W + d}{2} = \frac{s\,(W + d)}{4},$$

as representing the bending moment in the section



The Bad Economy of Small Pins.

each side of the pin. Now, if we suppose a perfectly fitting pin and neglect friction, then the part of the eye to the left of the arrow lines $c - c$, in Mr. STOWELL'S Fig. 5, begins to approach the condition of a string around a smooth peg, in which Mechanics teaches us the tension is equal at all points.

With a closely fitting pin, this condition of contact would probably be reached before the inside and outside fibre strains in the head had begun to differ greatly. This disposes of the part of the head to the left of line $c - c$, through the pin center without making necessary any great increase of

section over the body of the bar, providing the material is equally good in each.

As to the part on the right of $c-c$, it is not so easy to say. Fig. 1 shows a head in which the section past the pin is the same as the body of the bar. Now suppose the section of the bar to divide equally at the point b, and pass around the pin as shown by the dotted lines. The tendency then of the parts of this divided section between the lines $d\,b$ and $d\,c$, would be to pull apart; but this is resisted by the cohesion of the wedge $c\,c\,b$, along the dotted lines.

Near the line $d\,e$ would probably be a section of contraflexure, and beyond that the tendency would probably be for the head to draw down to the pin and this condition would of course exist all the rest

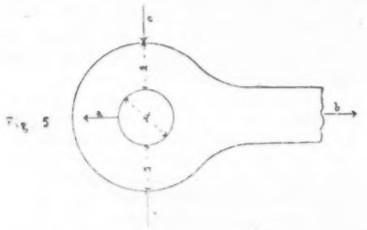


Fig. 5

of the way round the pin. This part of the eye can draw down to contact with the pin if the play in the pin hole is $\frac{1}{32}$ in., or less, without causing any serious inequality in tension between the inside and outside fibres of the head.

Taking this view of the strains produced in a bar head by tension I am inclined to think that the principal reason for allowing extra material past the pin is the injury to the quality of the material caused by the process of forming the head, and I am not surprised to see that the Edge Moor head mentioned by Mr. STOWELL, having an excess of only about 10 per cent., broke in the body of the bar at a strain not far from what might reasonably be expected. It would also be reasonable to expect that the eyes would be slightly elongated in adjusting themselves to the pin.

In view of the foregoing I am therefore obliged to say that I cannot agree with the opinion of Mr. STOWELL expressed in his closing lines, viz: that his theory of the strains in bar heads is as reasonable as the present theory of strains in pins.

Very respectfully,
HARRY J. LEWIS.

Web Stresses With Curved Chords.

DEFIANCE, O., April 1, 1888.

EDITOR ENGINEERING NEWS:

I intend in the following article to develop the theorems of articles 17 and 20 of Burr's "Stresses on Bridge and Roof Trusses" into a short and easy formula that shall not require the chord strains to be known, and that is applicable to any truss of *any shape whatever* with a single system of bracing, and of *any and every length of bay or panel*, that will show the nature of the stress, and the position of the load for maximum stress, the alteration of shape necessary to change the stress, and the modification necessary for forces inclined at various angles. Also a short graphical method for the curved forms in ordinary use.

First, consider the vertical forces, the first formula is deduced as if for weights only, but the modification necessary for upward forces is simple.

Let a plane be passed cutting the chords $A\,B$ and $C\,D$, and the diagonal $B\,C$. Then Fig. 2 represents the polygon of forces, (See Art. 17 of the above named work), $a\,d$ is the shear $= S$, $a\,b$ and $c\,d$ are the chord strains, and $b\,c$ is the stress on the diagonal.

Let S be the shear on the left side of the plane.
" M " " " moment that $A\,B$ resists.
" M' " " " " $C\,D$ "
" p " " " horizontal projection of the web piece.
Let v be the vertical. " " "
" H " " " horizontal components of stress on the web piece.
Let V be the vertical components of stress on the web piece.

Then from Fig. 2, $H = \dfrac{M}{A\,C} - \dfrac{M'}{B\,D}$ (1) and $M' = M + S\,p$ (2) Let Z be the horizontal distance from C of the place of the intersection of the chords prolonged, then $A\,C = B\,D \times \dfrac{Z}{Z-p}$ and making $B\,D = -\,d$ we have

$$H = \frac{p}{d}\left(S + \frac{M}{Z}\right). \qquad V = \frac{v}{d}\left(S + \frac{M}{Z}\right)$$

Consider the case of a truss supported at both ends, and let the horizontal distance between the supports $= l$. Let the left support be taken as an origin, and let x be the horizontal distance of C from that support, and X the horizontal distance of the intersection of the prolonged chords from this origin. Then $Z = X - x$.

1st. Let a weight W be on the left of the plane of

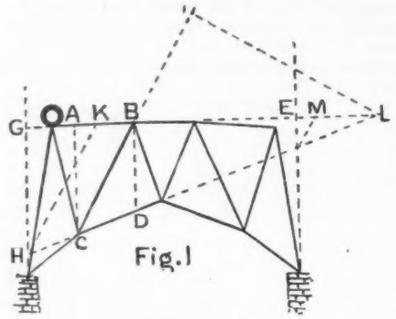


Fig. 1

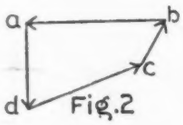


Fig. 2

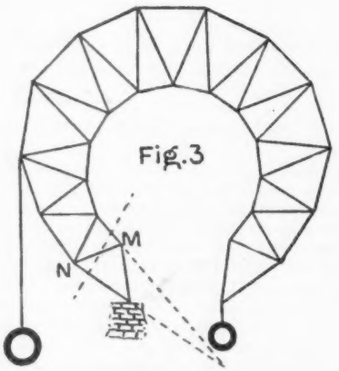


Fig. 3

section, and u be its distance from the left support then

$$S = -\frac{Wu}{e}, \text{ whence } M = \frac{Wu}{e}(l-x)$$

$$S + \frac{M}{Z} = \frac{Wu}{e}\,\frac{(l-X)}{X-x} = \frac{Wu}{e}\,\frac{(l-X)}{Z}$$

2d. Let a weight U be on the right of the plane of section u having the same value, then

$$S = \frac{U(l-u)}{e}, \quad M = \frac{U(l-u)}{e}x, \text{ whence,}$$

$$S + \frac{M}{Z} = \frac{U(l-u)}{e}\,\frac{X}{X-x} = \frac{U(l-u)}{e}\,\frac{X}{Z}, \text{ whence,}$$

by the process of summation we write,

$$H = \frac{p}{d}\left(\frac{(l-X)}{Z}\,\Sigma\,\frac{Wu}{e} + \frac{X}{Z}\,\Sigma\,\frac{U(l-u)}{e}\right) \quad (3)$$

Which is the formula sought. The vertical component is found by writing v for p and the resultant stress by writing t (= length of web-piece) in place of p. This is Prof. BURR's formula (given nowhere in this shape exactly), as may be shown by the relation easily found that IL, the perpendicular on the prolonged web piece to chord intersection, $= \dfrac{Zd}{t}$.

In most of the ordinary forms the intersections are acute and very distant. In this case, let $AC = D$, $GH = b$, and $EF = B$ (Fig. 1). Then we have $\dfrac{(l-X)}{Z} = \dfrac{B}{D}$ and $\dfrac{X}{Z} = \dfrac{b}{D}$. When the web piece is inclined there is a further simplification necessary. In Fig. 1, let $HK = k$ and $FM = K$, these lines being parallel to the web piece. Then $k = \dfrac{t\,b}{D}$ and $K = \dfrac{t\,B}{D}$ and if we know the sign of k and K the general formula may be written:

$$\text{Result. stress} = \frac{1}{d}\left(-K\,\Sigma\,\frac{Wu}{e} + k\,\Sigma\,\frac{U(l-u)}{e}\right) \quad (4)$$

a formula by which the numerical value is easily found, but care must be taken as to whether k and K are of the same or opposite signs. They are of the same sign where X is greater than l, or is negative.

The means of finding these signs, that is to say whether a particular loading causes tension or compression, will now be given.

The quantities X, x, p, v, Z, D and d are all algebraic. X and x are positive to the right, reckoned from the left support, p and v have their origin at that end of the diagonal distant x from the left support, and p is positive to the right and v is positive upwards. D and d have their origin at the joints from which they spring, and are positive upwards. Internal forces are reckoned positive to the right and upwards and are on that side of the cutting plane which is *nearest the right support* (reckoned around the truss, if of extraordinary shape). This is a consequence of equation (2). These forces are compressive when they tend toward the cutting plane, and tensile when they tend away from it.

It is not necessary that both reactions be upward. Thus: if in Fig. 3 there is equilibrium the equations given apply without any change, for the right hand weight is the reaction. Hence the equation is applicable to a truss fixed at one end and with a load at the other. For upward forces instead of loads, change the sign of W or U whichever it may be. When the forces are horizontal we may deduce analogous formula by commencing with the vertical component of stress, and using the horizontal distances from the joints to the opposite chords, the vertical ordinates of the chord intersection and of the joint. Having thus the stress due to both vertical and horizontal components the resultant stress is known. In some cases it may be necessary to change the axes of reference to avoid indetermination.

To illustrate the method of finding the nature of the stress take the piece $M\,N$ in Fig. 3, and consider M as the origin of p and v, and therefore the origin of D, while N is the origin of d. Then we have the following signs: p is $-$, d is $+$, X is $+$, Z is $+$. Whence, $\dfrac{p}{d}\,\dfrac{X}{Z}$ is $-$. Also since v is $-$, $\dfrac{v}{d}\,\dfrac{X}{Z}$ is $-$, and since in the figure $\dfrac{U(l-u)}{e}$ is $+$, the internal force in the piece acts to the left and downward and away from the plane that cuts the truss. If N were taken as the origin of p and v then these would both be plus but then d would be—because its origin is thereby transferred to M. Hence, whichever is taken we find the piece to be in tension.

This method of finding the nature of the stress, and the short method indicated by equation (4), so far as I am aware has never before been published. The latter may be made shorter yet if we assume a line $= \dfrac{Wu}{e}$, or $\dfrac{U(l-u)}{e}$, as the case may be, and may be solved easily by constructing two similar triangles, and thus obtaining a line which will represent the stress itself. The equations themselves show the manner the truss is to be altered in order to change the stress.

Yours truly,
C. H. LINDENBERGER.

Ice in Currents.

KEOKUK, Ia., April 14, 1888.

EDITOR ENGINEERING NEWS:

Does drift and ice in a *rising* river float in center, (or channel) or does it go to the sides when not affected by wind or other obstruction? Yours truly,
ED. M. GILCHRIST, C. E.

[We do not know; perhaps some one else does.—ED. ENG. NEWS.]

The Birth of the Electric Telegraph.

SING SING, N. Y., April 16, 1888.

EDITOR ENGINEERING NEWS:

I enclose to you an article written several years ago by my mother (formerly the Washington correspondent of the *Syracuse Journal*, "Chinquipin") on Dr. GALE's connection with the Morse telegraph invention. It was written for another purpose than it is now sent to you for. You can publish it if you see anything therein of interest. Mrs. GALE is an old acquaintance of my mother's—and so was Dr. GALE for that matter. Very truly yours,

G. H. THOMSON.

[We are pleased to be able to present such an interesting original reminiscence of the birth of the electric telegraph, which will be seen to correspond exactly with the facts which we narrated last week.—ED. ENG. NEWS.]

Having been for many years a frequent and favored guest in the family of a gentleman of great learning in this city, the late Dr. LEONARD D. GALE, I took occasion to draw from him a relation of that marvellous scene in New York University, when Prof. MORSE, having long been baffled in his attempts to send a message to any great distance, sought the aid and advice of Dr. GALE. Both of these gentlemen had recently been appointed to professorships in the then new university, GALE having been an assistant professor in the College of Physicians and Surgeons. At the opening, GALE was the only teacher on hand; Prof. MORSE, being in Europe, had hastened home to accept the position. GALE had chosen the large hall on the third story, overlooking Waverly Place, as his lecture room. MORSE on his arrival, took the room above, in the fourth story, the place that proved to be the cradle of telegraphy. Soon MORSE made the acquaintance of the young chemist, saying "Come up to my room: I want to show you something": Nothing loath, GALE mounted the stairs, and found in the room a table ten feet long, a jar of acid and a machine to make dots and dashes. [This is an error the machine did not make "dots and dashes", but a jagged line such as pictured in our last week's issue. The "dots and dashes" came later. ED.] Though hitherto, it seems, MORSE had been so secretive in respect to his invention that none but his own brother had ever been privileged to examine the mechanism, yet he at once confided to GALE the fact that he had so far succeeded, that he could project a message ten feet, but no further would it go. Could GALE give him any suggestion? GALE had never given any thought to the telegraph; he had, however, read in *Silliman's Journal* an article by one HENRY, describing an improvement in the electric machine by additional cups, and by a spool of wire. This improvement he had adopted, and in experiments before his classes, had found them highly valuable. He could not doubt that should his electric machine be applied to or connected with the invention of MORSE, more intensity, and consequently more power, might be gained. The proposed connection being made, the message rushed at once 40 ft. the extent of the wire at hand. Success so sudden proved overwhelming to Prof. MORSE, who stood pale and trembling, scarcely believing his eyes. Then and there was the telegraph born, Minerva-like, full grown. Later 400 ft. of wire, and further on, 10 miles of wire, were brought into requisition, with triumphant success, a purely American triumph, too.

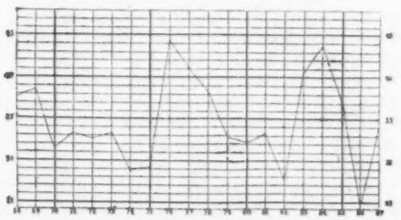
Though MORSE was poor, yet as soon as he could command means, Prof. MORSE proffered to Dr. GALE the sum of $1,000. This GALE declined, saying he claimed no merit in the case; MORSE, however, urged its acceptance. And to Mrs. GALE he offered the half of a large and costly gem given him by some Russian potentate, urging "For you and your husband have been my best friends". This Mrs. GALE declined. Does not this thrilling scene present a subject worthy the study of a sculptor? That historic hall in the University, adorned by a suitable tablet, would be visited by travellers from all lands.

It is but justice to say that MORSE directly called on Prof. HENRY, who expressed himself as highly delighted that his invention, which for the 6 years that it has been freely shown and explained had not been "caught up" by either scientists or speculators, would now become useful. Prof. MORSE inquired what would Prof. HENRY have; what would he accept, in the new enterprise: anything he would name or suggest should be his by right. Notwithstanding, Prof. HENRY was not long happy, though he declined any and all share, as he had ever refused to apply for a patent, deeming it beneath his dignity as a scholar. It is then not easy to account for the fact that "his countenance became changed" toward Prof. MORSE.

Is the Rainfall Increasing on the Plains?

Under the above head, F. H. SNOW, of Lawrence, Kan., discusses in *Science* a question which of late is attracting considerable attention, especially among scientists and the people living on the plains. Those who attended the convention of the American Society of Civil Engineers at Denver, in 1886, will remember that this question was also discussed there. The prevalent opinion has been that the rainfall has been increasing with the settlement of this section of the country, and it is very firmly upheld by the farmers and ranchmen living there. The writer has heard this opinion strongly upheld regarding Nebraska, and the higher lands of Wyoming, Utah and Idaho. On the other hand, it has been frequently and strenuously denied by those who ought to know.

As the subject is of such general interest to all, and has a decided bearing upon such engineering work as the construction of irrigating ditches, water-works and railroads, we give Mr. SNOW's letter in full, together with the diagram which accompanied it



Rainfall at Lawrence, Kansas, 1868-1888.

"In *Science* of March 2, I observe the statement attributed to the Chief signal officer, corroborating 'the prevalent opinion that the rainfall in the West is increasing,' while Mr. HENRY GANNETT 'dismisses this popular idea as baseless.' My own opinion is decidedly in favor of the affirmative of this question. My personal observations for 20 years at Lawrence, Kan., indicate the existence of a rainfall cycle of about 7 years in duration, each septennial period including two or more consecutive years with precipitation above the average, and a similar series of years with precipitation below the average. A 7-year cycle is also illustrated in the Fort Leavenworth rainfall, whose records cover double the period of my own observations at Lawrence. Recognizing the existence of this cycle, it will require a minimum series of 14 years of records to warrant a division of the period into two equal parts for the purpose of determining the question of an increase of rainfall. I would, therefore, eliminate from Mr. GANNETT's list all but nine of the twenty-six stations. (The seventeen not reaching back to the first period).

"At the remaining station the aggregate increase of precipitation in the second half of the periods of observation is 109 ins., which gives an average annual increase of 1.28 ins. for the nine stations. This is certainly a decided increase, although the average period of observation is only 19 years.

"But the length of the period of observation at Fort Leavenworth is 39 (instead of 28, as given in Mr. GANNETT's table),—from 1836 to 1874. A study of this series of observation is of great interest, since it is the largest series in our possession, and especially since its division into two equal parts throws the first half entirely into the period preceding the settlement of Kansas, while the second half is placed entirely within the period of settlement of this great Commonwealth. The total precipitation in the first half of this period (ending June 30, 1855,) was 592.84 ins., giving an annual average of 30.40 ins., while in the second half (ending Dec. 31, 1874,) it was 636.29 ins., giving an annual average of 35.70 ins. This shows a total increase of 103.45 ins., or an average annual increase of 5.30 ins. This is assuredly a change worthy of notice, involving an increased precipitation of more than 17 per cent.

"My figures concerning the Fort Leavenworth rainfall are derived from a transcript of the records furnished by Prof. JOSEPH HENRY, of the Smithsonian Institution, and published in the "Annual Report of the Kansas Board of Agriculture for the year 1874." In this transcript there are no records for 19 of the 468 months of the 39 years. Five of these blanks occur in the first half of the period, and have been filled by inserting the average precipitation for the months in question. Twelve of the blanks occur in the second half of the period, and have been filled by inserting the actual rainfall for those months at Lawrence, Manhattan, and Fort Riley, all of which stations are within about 100 miles of Fort Leavenworth, and have a smaller rainfall than that of Fort Leavenworth.

"The preceding diagram is appended as exhibiting more clearly this periodicity according to my observations at Lawrence.

"A similar platting of the Fort Leavenworth rainfall exhibits six periods of excessive precipitation, separated by intervals of 7 years, and alternating with periods of deficient precipitation, in the same manner as in the above diagram of the Lawrence rainfall."

Cable Railways.

The following matter is abstracted from a report by Messrs. DOANE and PLIMPTON, engineers of the West End Street Railway Co., of Boston, as the result of an examination of the various cable systems in use in all the large cities excepting San Francisco:

The first radical difference in the systems is found in the cable conduits; the yokes being made of cast iron, or steel angles, or of railroad iron and plates. The usual depth is 3 ft. below the surface, though Cincinnati uses a conduit only 2 ft. deep, and supports the rails in wrought iron brackets bolted to the yoke. All of the companies have from two to four times as much engine power as is required at any time, with one and one-half to twice the boiler power. The horse-power of engine per mile of cable varies from 200 H. P., on some of the Chicago lines, to 64 H. P. on a Philadelphia line, and 60 H. P. on the Grand Avenue road of Kansas City.

The usual cable is 1¼ ins. in diameter and made of 6 strands surrounding a central hempen core; the cables weigh 2½ lbs. per lineal foot and their maximum wear is about one year, or 60,000 miles of travel. When they have stretched 1 per cent. in length they are considered worn out or unsafe. The most of the cables are made by JOHN A. ROEBLING SONS, at Trenton, N. J., and while English cables were once considered better, this is not the case now. The best cable length is 20,000 ft.

The cable speed ranges from 7 to 14 miles per hour. The principal grips in use are the HOVEY, in South Chicago, and one very similar to it in New York, the ROOT grip in Kansas City and St. Louis, and the LAURE grip in Cincinnati. All of these are vertical working grips grasping the top and bottom of the cable. In Philadelphia is another style of grip catching the cable on the sides. These grips and their attachments average about $100 each in cost, with all the parts interchangeable.

There are three styles of cars in use; in Chicago an open grip-car is used with the grip-man in the middle of it, and to this car 3 or 4 common horse cars can be attached. In Kansas City a combination car is used, open in front for the grip-man and carrying passengers in the front and rear portions, 40 passengers in all. The car has 8 wheels running on two trucks like a railroad car. The third and most common plan of car carries the grip-man on the front platform, reserving all the remaining space for passengers.

The horse-power required per car, as obtained from various cities and companies, varies from 1⅓ to 9 horse-power each, for the same rate of speed. The Chicago, St. Louis and Philadelphia lines traverse nearly level routes; while Kansas City, New York and Cincinnati lines have steep grades. Kansas City has on its Ninth St. line grades of 15⅓ to 18½ ft. per 100; Cincinnati, on the Vine St. road, has grades of 8 ft. per 100, and New York, 7 ft. per 100. The horse-power per car seems to have a close relationship to the amount of business done on the several lines. The putting on of cars does not seem to increase the required engine power, but decreases the horse-power per car.

The investigators report that the slot rail generally used does not appear to be strong enough and they recommend heavier rails for Boston use and stronger yokes or frames. They approve of the HOVEY as the best grip in their judgment. In the matter of running expenses, the engineers estimate that the item of fuel, which constitutes about one-half of the cost of power in running cables, will be greater in Boston than in any other city. The street expenses, in care of slot and switches, oiling carrying and curve pulleys, etc., they estimate at about $32 per day per mile of track, requiring the time of one man per mile of single track.

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EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club of Philadelphia, Pa.—Regular meeting, April 21. Secy., Howard Murphy, 1122 Girard St.

American Society of Civil Engineers, New York.—Regular meeting, May 2. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis.—Regular meeting, May. 2. "Standards of Boiler Efficiency", Col. E. D. Meier; "Failure of a Firmenich Boiler", C. F. White. Secy., W. H. Bryan, 709 Market St.

Engineers' Club of Kansas City, Mo.—Regular meeting, May 7. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting, May 7. Secy., Geo. L. Wilson, City Hall.

American Society of Mechanical Engineers.—Next meeting at Nashville, Tenn., May 8 to 11. Secy., F. R. Hutton, 280 Broadway, New York City.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, May 16. "Small Pipe Sewers." Secy., S. E. Tinkham, City Hall.

Master Car Builders' Association.—Next convention at Alexandria Bay, N. Y.; commencing June 12. Secy., M. N. Forney, 45 Broadway, New York City.

American Railway Master Mechanics' Association.—Next meeting at the Thousand Islands, N. Y.; June 19. Secy. Angus Sinclair, Chicago.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reed, Waycross, Ga.

THE report of the Board of Engineers on improved terminal facilities for Providence, R. I., which is abstracted in another column, may possibly not be carried out at once in full, but it is another significant indication of the tendency of the times to correct the great evils which have gradually grown up in all our cities from the simultaneous and rapid growth of great cities and great railway systems on the same spot. When both the cities and railway systems were young the evils were not felt, nor was it reasonable then to expend large sums in eliminating highway grade crossings, erecting large buildings and other improvements of that nature, which are now so much needed. Year by year the situation grew worse, but so gradually that all concerned became accustomed to evils, as if a part of the eternal order of things, which would never have been tolerated nor thought of if they had had to be suddenly introduced. In England vast sums, rising into hundreds of millions, have been expended on such terminal improvements since the first construction of the roads, despite the fact that no expense was spared in their original construction to provide fully and permanently for the future, so far as it could be then foreseen. In our country such works have come later, as was but natural, but they are now imminent at Buffalo, Pittsburg, Montreal, and other cities, as well as at Providence, while they already exist at St. Louis, and for single lines at New York and Philadelphia. Ten years from now their number will be greatly multiplied, and in twenty years the chances are that they will be well nigh universal here as in England in towns of any size. The plans for Providence seem admirably adapted for the requirements, and although the important question of who is to pay for carrying them out is not yet fully settled, there seems reason to hope that it will be amicably agreed on and that work will soon proceed.

THE plan for the improvement of the Reading terminals at Philadelphia, described on our ENGINEERING NEWS page, another move in the same direction as the above, can hardly fail to result profitably to the railroad company and very beneficially to the public at large. The main defect in the plans as published, seems to be the retaining for occasional use of the existing surface tracks in the heart of the city; for while the number and speed of trains running over these crossings will of course be greatly diminished, the vigilance of vehicle drivers and pedestrians will be largely nullified, from the fact that trains are so infrequent, and it cannot be expected that the diminution in the number of casualties will be proportionate to the reduction in trains. Add to this the delay at crossings from the movement and switching of slow freight trains, and the cost of the real estate which the company has to retain for its storage tracks, and it seems that it would be good policy for the company to vacate entirely its existing surface tracks much more extensively than it is now planning to do.

The great public opposition which was aroused almost as soon as the definite plans of the Reading Company were made public, is not, however, especially due to enmity to the old grade crossings. It might be supposed that the promoters of such a manifest improvement as the securing of a real rapid transit road from Market Street to the north part of the city might reasonably expect a favorable public sentiment toward their plans; but that is not the way in which innovations upon the customs of former generations are treated in the City of Brotherly Love. The Arch Street property owners have published a monster protest against the proposed crossing of Arch Street. The Philadelphia Traction Company and other street railway companies and the Pennsylvania Railroad, all of which companies would have their traffic more or less diverted to the new road, are said to be using their influence to defeat the plans in the City Councils; and such property owners as are not exerting themselves to defeat the enterprise are doing nothing to aid it in its hard task of securing the official consent to the proposed improvement. The petition of the Arch Street property holders charges that, "a viaduct of the necessary width across Arch Street will inflict great injury on that street", others think that a bridge across Broad Street will be a great obstacle and detriment to travel. In other words the city where carriages, trucks and pedestrians have threaded their way among moving freight and express trains at a hundred grade crossings for many years, is now greatly exercised lest a few bridges to carry trains *over* the streets will "inflict great injury" on these thoroughfares for business purposes.

We confess that we admire the straightforward business course which President CORBIN has uniformly pursued in the reorganization of the Reading company so as to place it once more on a sound basis where it shall be able to keep up with the times in providing accommodations and facilities for the public. The plans above referred to, will certainly result in large benefits to the Reading company, but they might well have been deferred till the finances of the company were in better shape and its credit abroad was fully restored before being put into execution, had the interests of the company alone been considered. It was, doubtless, realizing the value of the good will of the citizens of Philadelphia, and the necessity from a humane point of view of a change in the existing order of things that the new plans were prepared. How much then is it to be deplored that the natural opposition of competing corporations has been supplemented by the very people most to be benefited, and that the company, if it carries out its proposed plans, must carry them out against enormous odds. The officers of the company may well be discouraged at the reception their beneficence has met, and it would not be at all remarkable if the Reading Terminal scheme was finally abandoned like the many schemes for elevated roads, underground roads, improved sources of water supply, better pavements, and better drainage for the slumbrous city of Philadelphia which have gone before it.

THERE seems to be no end to the Boston water meter tests and investigations. In addition to the long series of official tests, Mayor O'BRIEN requested Water Registrar DAVIS to test the Hersey, Balance Valve, Ball & Fitz, and Desper & Spooner meters. Later, a hearing was granted, on request, to the National Water Meter Co., who claim that inaccurate statements have been made in official documents concerning their meters. The chief grievance of the manufacturers of the Crown meter lies in the declaration made by the water Registrar in his report; "that the Crown meter also shows good qualities under a bench test, but in real service, under certain conditions, it works intermittently, passing water at times without recording. This is a vital objection, since it causes great dissatisfaction among consumers, by varying charges where the consumption is quite regular." The National Meter Co. also objects to certain tabulated statements which appeared in the above named report. Some of these figures, however, were afterwards corrected, as having been wholly a mistake on the part of the clerks who made up the tables, they having inadvertently inserted figures from the test of some other form of meter. The hearing is not completed at the present writing, and the conclusion of the whole matter appears to be that the investigations have been very queerly conducted, to say the least, and that a series of tests which ought to have been of great technical value, and practically conclusive, will be neither the one nor the other, for lack of attention to the proper methods of conducting such an investigation.

A CORRESPONDENT sends us the following interesting, and we may say instructive, reminiscence of early railroading in Missouri:—

"In *ante-bellum* days the State of Missouri adopted a comprehensive system of State aid to railroads by the issue of bonds to aid in their construction, saddling itself with a railroad debt of about $20,000,000. One of these roads, designed to connect St. Joseph with Council Bluffs, Ia., instead of following the Missouri river bottom to Forest City, in Holt County, 28 miles, was located by the senator and representatives from Andrew and Holt Counties, through their respective county seats, over a hilly country, a distance of about 38 miles, to Forest City aforesaid, and was actually built as far as Savannah, 15 miles, running through the farm of Senator ROBERT WILSON, of Andrew County; involving a

2 per cent. grade containing a reverse curve; and the grading was three-fourths done on the remaining 23 miles. This location was entirely abandoned for the river route after the war. When the charter for the Hannibal & St. Joseph R. R. was pending, the member of the legislature from Marion County, who resided in Palmyra, the county seat, refused to support the charter unless the line was located through his town, and the opposition to a road to be built by Boston capital was so strong that his vote had to be secured in its favor. The road was accordingly so built, on a 90 ft. grade, with a 600 ft. trestle about midway, and with about 170° of curvature visible from the Palmyra station. The M., K. & T. R. R., built later, naturally follows Bear creek on a line 6 miles shorter and a 1 per cent. grade, and at Monroe is within a quarter of a mile of the line of the H. & St. Jo. R. R. By the way, the terminus on Missouri river was offered to Weston, Platte County, one of the foremost hemp markets of the State, then larger and doing far more business than St. Joseph, but was refused by the two members from Platte County, as the road, if built through their county, 'would run all our niggers off, sah, suah.'"

By an unfortunate accident the word "London" was interpolated in front of the title of our esteemed New York contemporary *Building* in our issue of April 7 in abstracting from it some data as to the combustibility of ceilings of various construction. Our contemporary is too well known and too well esteemed in its specialty for us to be willing or disposed to expatriate it, and we extend it an apology.

Mr. JAMES S. HOGG is the Attorney-General of the Sovereign Commonwealth of Texas, and is, we presume, also an honest and conscientious man. He is zealous to defend the public from the various enemies which he conceives threaten it, in whatever guise they may appear.

It seems that recently Mr. HOGG has come to the conclusion that the railroad corporations, which are now doing business in the State of Texas, are not the beneficial and necessary adjuncts to civilization which they are commonly supposed to be, but are rather a species of legalized robbers who have maliciously conspired together to practice extortion upon the law abiding Texans by charging higher prices for the transportation of freight and passengers than is just or right. This they have done by the formation of the Texas Traffic Association, which fixes rates of transportation for all the railroads belonging thereto, and thus does away with that free competition which Mr. HOGG considers to be highly essential to the public welfare.

Nor does Mr. HOGG believe in any light punishment for transportation companies which fail in any point of their duty to the public. If memory serves us rightly, it is not long ago that he brought suit to compel the forfeiture of the charter of the International & Great Northern Company, alleging that the road was not being maintained in a safe condition. Like severe measures are called for in his new crusade, and he is endeavoring to enlist in the same cause the Attorney-General of the State of Kansas.

Before Mr. HOGG proceeds farther in his crusade, it would be wise for him to consider whether the railroad companies who are now carrying the traffic of Texas are making profits on their capital invested greater than is a usual return to other business of similar risk in the State of Texas. When he finds that they are not doing so by any means, as he soon will, he may then inquire whether the companies are wasting their income from these "extortionate rates" by paying too high wages to their employés or by expending more money in securing safety and convenience for their patrons than is desirable. Unless he finds this to be the case, it would seem to be plain enough to an unprejudiced person that the railroad companies of Texas are not injuring any person or interest by their present mode of doing business and are entitled to the protection of the government in common with other law-abiding property owners. If Attorney-General HOGG is anxious to busy himself in the service of the public by ruining some well established industry, he will be employing himself much more usefully in chasing the gentlemen who still pursue the avocation of train robbing until they take refuge inside the walls of the State penitentiary; and he may thus help to secure for the Lone Star State a reputation for law-abiding peacefulness which it has not yet attained. He will thus do as much good in encouraging the investment of capital to develop the resources of Texas as he now bids fair to do harm by frightening it away.

The Rail Joint Question.

We devote considerable space this week to the presentation of three new devices for remedying the defects of the ordinary angle-bar joint. Each of them, in our judgment, possesses great merit, and will be a vast improvement on the common type of joint, which it is much to be regretted should any longer continue to be the "common" type. If anything can be considered to be settled by experience it is that short fish-plates or angle-bars of any form whatever, relying only on four bolts through the neck of the rail to hold the rails together, cannot be regarded as a good, durable or economical joint, and if this plain fact were acted on it would greatly help to a speedy decision of the question of what is the best substitute.

This we take to be especially well demonstrated for suspended angle-bar joints. We are not unmindful of the fact that in Germany, and on the Continent generally, we might almost say, the suspended type, on the whole, has been given the preference; but there are two radical differences between their conditions and ours. The rails for the most part are heavier, and both the engines and cars are lighter and run at slower speed. At any rate, here in this country, suspended joints of this type have broken by the thousands, while the evidence is emphatic that long three-tie supported joints hardly ever break, and that the same is true of the Fisher bridge joint, if it be denied all other merits. It is equally well determined that the short supported joints break much less frequently than suspended ones.

The radical defects of the plain angle-bar joints are, two: First, it does not hold the two ends of the rail rigidly together in the same plane, so that the loaded and unloaded rail-ends must bend together if they bend at all, but permits them to move up and down past each other by whatever amount of play there may be between the rails and angle-bars. This must always be something from the first, and it is increased by wear. Secondly, in so far as its splicing action is effective, it attempts to bend the rail-ends into a reversed or ogee curve, and as it is obviously unequal to this duty, intense pressure is produced under the very end of the rail, which rapidly causes an unequal wear at that point, and so destroys the possibility of making the joint tight by any amount of tightening of the bolts.

To cure the first of these defects is the chief end of all three of the joints which we illustrate, and we cannot perceive why they should not do it effectively. The first one, the new New York Central joint, accomplishes this end by use of Bush interlocking bolts, which bind both rail ends firmly down to the tie, independently of the angle-bars; so long as the wood of the tie remains sound they must do this effectively, for the bearing surface on the tie is so large that no great amount of indentation can occur, except very gradually, and all that is needed to take out this is to screw up the bolts occasionally. The second joint shown does this directly by a U-bolt, and the third does it indirectly, without cutting the angle-bars, by wedging clips held together by a bolt under the rail. That each will immensely decrease abnormal wear of rails at the joints seems certain. The same end is accomplished in the Fisher bridge joint directly by the U-bolt which passes through it, and is one of the greatest merits of that joint.

The second defect may be cured either directly, by abandoning all attempt at fishing, as in the Fisher joint, or it may be cured indirectly by furnishing so much extra support at the joints that there will be less tendency of the rails to settle there, and consequently no considerable bending and unequal wear. The evidence seems to be clear that the three-tie joint does supply such extra support, and so greatly reduces, if not entirely eliminates the tendency to unequal wear. It is this fact, and not that the greater length makes the fish itself any stronger or more durable, which constitutes the merit of that joint. It obtains first, a direct support from the joint tie, and secondly a bridge support from the two adjacent ties, analogous to that which the Fisher joint obtains by its bridge action in connecting two joints. Regardless of the joint, moreover, each rail end independently has additional support. There is an admitted theoretical difficulty in combining the two distinct means of support just mentioned effectively. If the joint tie be very low for example, the bridge strength alone will be unequal to adequately supporting the joint and permanent set or fracture may result. On the other hand, if the bridge tie be too high there will be an obvious tendency to rocking action which, would also be very destructive if long continued.

But on the other hand there is a conservative tendency, that whatever ties are too high will tend to take most of the strain, and so settle and relieve themselves, and if the track be fairly well surfaced in the beginning this conservative tendency seems to be very effective in its action, and to ensure sufficient uniformity of strain to bring the double support into action and so maintain a reasonably permanent surface which does not permit of the settlement which is so destructive. It must be apparent, likewise, that the mere tying together fixedly of the two rail ends, so that both must deflect together, if at all, will greatly increase the effectiveness of the tie support, even if there be only two ties, because it is no longer possible for the loaded rail-end to deflect without the other, throwing the whole wheel-load on to one tie, and then suddenly relieve it and throw the whole load on to the next tie by striking the second rail-end. Not only is the resistance to bending of the rail itself doubled by tying two together, but both ties catch a portion of the strain, whichever one the load is over. This must inevitably be highly beneficial.

We must confess that we think very highly of the principle of the Fisher bridge joint, even if the joint itself, in the form it is now before the public, be not perfect. A great defect with that joint in the past, as it has been with all other joints, has been that too little material was put into it, for the sake of economy in first cost. It is a most fortunate fact that such economy is falling into discredit, as a very costly one. Since the life of the whole rail, which costs perhaps $12 in the track, is limited by the life at the joints, it is really a most extravagant economy to save a few dimes at the joint, if its excellence is thereby

injured. Given sufficient material properly disposed in a Fisher joint, we fail to see why it should not make an excellent and irreproachable joint. The two rails are held firmly together on a solid base plate; the wear is on broad flat surfaces, and does not tend to produce looseness, old joints can be used with new rails and *vice versa*; two joint ties are bridged and act uniformly together wherever the load is. These are great merits. On the other hand, it is claimed that the lining of the heads is not so well maintained as with fishing, and if the shanks are bent, as they are in nearly all rails, more or less, there is a positive lateral jog; but without going into details now in this matter, it seems to us that these objections are of a minor character, even if they are not easily remediable. We must not be understood to assert that the Fisher joint has not sufficient material in it, or even that the addition of more would not be a positive injury to it, but it is always a probability that there will not be too much, but will be too little, and the precise proportions which are best for any joint are determined only by long experience.

But the Fisher joint is a radical change from existing types which it is only natural that engineers should shrink from, and it is undeniable that there is a strong feeling among many of our most experienced engineers that modifications of and additions to the existing type of joint will prove the best in the end. This feeling, being the fruit of much experience and observation, is entitled to great respect, and when we see that the greatest of all defects in the common angle-bar, the tendency to play up and down at the rail-ends, can be cured by so simple expedients as those we illustrate, it becomes the part of the plainest wisdom to try these and study their effects, which beyond all question will be good, and so good as to make them highly economical. The last two apply only to suspended joints and the first to supported joints. We are not aware that the experiment has been tried on any considerable scale, but it appears to us that the use of the Bush interlocking bolts at supported-joint 24 in. angle-bars in the same manner as they are used in the new New York Central joint, but without cutting the angle-bar entirely away, would be a most interesting and promising experiment. A hole could be drilled through the base of the angle bar, as is needed for the Otis joint, and a clip used with a projecting lug to pass through it instead of a flat plate. Great reduction of wear would probably result. The most dangerous feature of the new New York Central joint would seem to be the complete cutting away of the base of the angle bar at the center. It may do no harm, and there are strong arguments to advance why it should not, but we should be a little afraid of its introducing a tendency to fracture. That it is otherwise a great improvement on the plain type is very clear.

Too Short.

We find in a local daily the following interesting advertisement:

WANTED TO SELL,

AT ONCE.

A First-class Iron Bridge.

One hundred and five feet long, was built for the Central * * * R. R., but was not quite large enough. Will make a splendid Highway Bridge for some town.

It can be bought at less than half Price.

Will hold up with safety 250 tons. We want to sell this and other bridges. We will consider any offer.

The * * * * Co.

* * * *. Vice-President.

Certainly a railroad bridge which will carry safely 4,760 lbs. per running foot, as the above advertisement avers, ought to be a splendid highway bridge for any town as far as safety is concerned. If, as appears from the above, the company are anxious to sell it at less than half price, it certainly seems that they must have been making a snug profit in the first instance in order to be able to make such a reduction in their present offer, as there is no apparent reason why a good "misfit bridge" should be regarded as entirely dead stock; there must be larger margins in the iron bridge trade, as carried on in some parts of the country, than has been ordinarily supposed.

The most interesting query which arises from the above card, however, is how it came to be built for the—R. R. but not be quite large enough. Possibly the stream it was to cross grew a little, after the span was measured; or perhaps it was too narrow or too low to give a proper clearance for the heads of tall brakemen or for track-walkers caught on the bridge. A person of a suspicious turn of mind might suspect that possibly the bridge was condemned by the railroad company's engineers for poor workmanship or defective material, for it should be almost impossible to suppose that an engineer entrusted with the measurement and design of a bridge span would make such a radical mistake in its length that it would be impossible to use the structure for that site even by tinkering the masonry or truss. From information from other sources, however, we believe that the latter is the true solution, and that the bridge was actually so short that it could not be placed on the piers at all. It is certainly to the credit of the railroad company's engineers that they did not permit the structure to be doctored by the addition of an extra panel; a species of remedy which is not entirely without precedent, in the case of wooden bridges at least.

To the best of our knowledge and belief, however, and we happen to have some sources of information, the root of this little unpleasantness lies in the fact that the managers of the company have so small an appreciation of the value and importance of good engineering skill that they have taken no pains to secure it, and to all appearance, considerable pains to repel it, and while we have no evidence that their structures are not well designed and built, in one other instance at least, they have shown a carelessness in this very matter of measuring and locating bridge sites which is only laughable because it injures no one so much as themselves. In this case, an engineer in their employ was to locate the piers for a bridge of several spans across an arm of a lake, and began to measure a base line on the shore. His superior, however, objected to this as a piece of useless refinement, and the piers were located in some hap-hazard fashion, the details of which, we regret to say, we are unable to spread before the profession. After the scows had dumped in a large amount of rip-rap "near enough" to the proper place, as was supposed, and the rip-rap began to appear upon the surface "near enough" to have its locality checked without any fooling with base-lines, it was found to be far out of place, and the manager of this very company which now has a misfit bridge to sell came to the conclusion (at least it was so supposed then) that it might have been economy to have gone on at the start, and located the piers by a base-line as his engineer proposed, since the work had practically to be done twice over; nor was this so very many years ago.

Experience keeps a dear school, but—one term at it is usually enough. In this case two terms have been taken, and we trust that will suffice.

Lest the improper moral should be drawn from this anecdote that all that is necessary for accuracy is to triangulate from a "base-line" we will mention one other incident of a contrary nature where an engineer with too much reliance on a "base-line" came to grief. He was in charge of an important bridge with a long series of rather short spans over shallow water, and was ordered by his chief to not only locate his piers by triangulation, but to check them by piano-wire direct measurements. This he deemed beneath his dignity, however, or at any rate neglected, and when the erection of spans begun it was found that one span was too long by the batter of the masonry, the bottom of the piers being where the top should have been, and that one of the intermediate piers was just 10 ft. out of place! Almost every engineer has to have his little experience of this kind before he learns to be careful, just as the famous oculist had to spoil his "hatful of eyes" to learn how to make a peculiar operation, but few need a lesson on so large a scale, and we never yet heard of an instance, until the one which prompted this article, where the same man on the same road needed the same lesson repeated.

We may add for the benefit of possible purchasers that the bridge above advertised is still for sale, that as a highway bridge it is probably a bargain at the price named, and that the address of the parties which have it for sale can be learned on application to this office.

PERSONAL.

M. A. ORLOPP, Jr., has been elected City Engineer of Little Rock, Ark., for the ensuing year.

R. H. SOULE, General Manager of the New York, Lake Erie & Western R.R., has resigned his position; the resignation taking effect April 30.

PETER C. HENSEL has been elected Superintendent of Water-Works, at Lancaster, Pa., to succeed JACOB HALBACH.

THOMAS SILVER, civil engineer and inventor, died in New York, April 12, at the age of 75. His most widely known invention is Silver's marine governor, for marine steam engines. He was made a member of the Franklin Institute, Philadelphia, in 1855.

ALFRED NOBEL, the inventor of dynamite, died at Cannes, April 14. The list of men is not long who have conferred greater benefits on mankind, and still shorter, of those who have seen as great results flow from an invention only 25 years old.

ISAAC N. MARSHALL is appointed Division Superintendent of the new Providence Division of the Old Colony R. R., in addition to his duties as Superintendent of the Northern Division. The duties of the general officers of the road will extend over this division, including J. N. LAUDER, Superintendent of Rolling Stock; GEORGE S. MORRILL, Chief Engineer; S. L. MINOT, in charge of construction work, new stations, and rebuilding of bridges, now in progress. The Old Colony R. R. Co. having leased and assumed the operation of the Boston & Providence R.R., the railroad from Boston to Providence, with the West Roxbury, Dedham, Stoughton and North Attleboro branches, will be known as the Providence Division.

Improved Terminal Facilities for Providence, R. I.

A commission of engineers, consisting of JOS. M. WILSON, DON J. WHITTEMORE and ALFRED P. BOLLER, have just submitted to the City Council of Providence carefully studied plans for new terminal facilities in that city, which provide for the separation of freight and passenger traffic, the straightening of through tracks, a new and conveniently located passenger station, better facilities for handling freight, the removal of all grade crossings by streets, and the filling in of the Cove basin, preferably for a public park, but available for business purposes if thought best by the city.

It is proposed to locate the new passenger station near the old State Prison, at the foot of Smith's hill. The station will be 560 ft. long and adapted to the needs of the various railways. It will have seven continuous tracks passing through it, two for

through freight, two for through passenger, and three for local trains. These tracks are to be separated from the freight yards of the various railway companies. The four projected main tracks are so located that a distance of 1,730 ft., and a curvature of 79½° is saved for the Providence & Worcester, and the Boston & Providence railways. The Commission have estimated that this change alone would save money enough to pay 5 per cent. interest on about $200,000. Passenger tracks would be crossed by those for freight, but it is proposed to use interlocking signals at the crossings.

Provision is made on the Providence & Worcester for 10,000 ft. of standing room for freight trains, and on the Boston & Providence for 13,000 ft., and this does not include switches, or tracks in buildings.

Some changes are proposed in the streets. The one in front of the station is to be 100 ft. wide, and those connected with it are to be widened.

The other features of the proposed improvements consist principally in converting the Cave into a public park. This is considered at length in the report of the experts. It is also recommended that the Mochassuck river be made a covered conduit for surface and river water, and that the Woonasquatucket river be conducted through the park. If the river is as large as its name implies, however, there will hardly be room for it in an ordinary park, and in this respect the report seems open to question. The report also advised the construction of a belt-freight railway, which is already begun, and the removal of the tracks in Dorrance St. and across Market Square. When officially submitted the report seemed to meet with general favor, and it seems to be generally hoped that its provisions will be carried out.

Report of the Brooklyn Bridge Terminal Committee.

The Terminal Committee of the Brooklyn Bridge Board of Trustees very unexpectedly, and without the slightest previous notice of their intentions to any one, submitted the following report at the special meeting of the Trustees, called to consider the report of the Board of Experts, in which the recommendations and conclusions of the Experts are summarily thrown at one side, and a plan adopted without debate which neither the Experts nor any one else other than its author had seen before, but which is of a type unequivocally condemned in the Experts' report, and differs only in detail from the specific plans which were laid before the Experts from the same source and rejected. That the course of events in this matter may be comprehended, so far as it is comprehensible, we submit the following brief resumé of the facts:

In our issues of March 17 and 24, we published the report of the Board of Experts who were appointed by the Terminal Committee of the Board of Trustees to examine and report upon plans for the enlargement of the capacity of the bridge. That Board, consisting of WALTER KATTÉ, Chief Engineer of the New York Central and the West Shore Railroads, Col. JULIUS W. ADAMS, Ex-President of the American Society of Civil Engineers, and JOSEPH CRAWFORD, Superintendent of the New York Division of the Pennsylvania Railroad, examined seventeen plans or modifications of plans, and reported to the Terminal Committee, after several months' study of the matter, that "of all the plans submitted to our review the one alone which seems best to conform to the necessary conditions, is the simple 'circulating system', as represented in its general design by the plan offered by Mr. A. M. WELLINGTON, C. E., in which the objectionable features of all the others are eliminated." The "objectionable features" were specified in detail for the "tail switching" system (now adopted) the "head-house" system (that which was before adopted as summarily as this has been, but which the discussions of this journal published June 4 and 11, aided by the resulting demand from the daily press at last caused to be abandoned) and the "loop" system, a peculiar arrangement differing materially from the "circulating" system, except in the one feature of having an endless track, which we will not now attempt to describe.

The Terminal Committee is the same which has acted in this matter from the first, but by the absence of Mr. CHAS. MACDONALD in Australia consists only of Mr. THOS. C. CLARKE and JAMES HOWELL, *ex officio*. Mr. CLARKE, we are informed, expressed himself in writing to the Board of Experts after their report was in as "entirely agreeing" with all their conclusions, but for some reason he appears to have suddenly changed his views, perhaps because of the exaggerated estimate of cost which appears below.

This does not seem the proper place to discuss the details of this estimate, but besides the unusual and plainly improper feature of preparing and acting on any estimate whatever in secrecy and haste, without even the formality of previously consulting the author or endorsers of the plan, it appears to be entirely unfair in its substance (1) in exaggerating by more than 100 per cent. the proper comparative cost of providing for 18 car trains, (2) in suppressing all reference to the fact that 14 car trains only were originally proposed, at less than half the cost for 18 car trains, which was an increase made only at the suggestion and request of the Board of Experts, (3) in suppressing all mention of the fact that there are very large operating economics in the circulating system, as notably in saving all expense for switching engines, which are great enough to far more than balance the interest charge on the fair and necessary cost, leaving the system which has been so hastily adopted, not only admittedly inferior in other respects, but likewise more expensive.

REPORT OF COMMITTEE ON TERMINAL FACILITIES.

To the Board of Trustees of the New York and Brooklyn Bridge.

GENTLEMEN: The undersigned, on the 23d of February, received from the Board of Experts their report on the enlargement of traffic facilities at the New York terminus of the bridge. This report, which you have received, is a very careful and exhaustive one, worthy of the reputation of its authors, and one which clears the way toward arriving at definite conclusions.

The Board of Experts were not asked to estimate the cost of the improvements recommended by them, and immediately upon receiving their report the Chief Engineer, Mr. MARTIN, was instructed to make careful estimates of the cost of lands, buildings, new machinery and cars necessary to apply the circulating system as designed by A. M. WELLINGTON, C. E., to both termini of the bridge. His report, just received, gives the cost as follows:

Description.	New York. Term'us	Br'klyn Term'us	Total.
Real estate for stations...	$1,797,750	$ 456,500	$2,254,250
Real estate for store yards	——	448,000	448 000
Station buildings.....	1,100,000	1,100,000	2,200,000
New plant and machinery	——	——	475 000
100 new cars.....	——	——	400.000
Total.....	——	——	$5,777,250

This is a very large sum, and one which it might be wise to expend, so far as it would go, in providing new bridges and tunnels, rather than to expend it upon the present bridge.

The attention of your committee and that of the Chief Engineer was then directed to see how the present system can be enlarged. The Board of Experts in their report (p. 10), say:

The maximum capacity of the bridge railway can only be attained by increasing the number of cars per train to the limit most desirable in actual service (which experience in operating them alone can demonstrate), and in fixing the headway intervals as short as absolute safety requires for handling trains of increasing lengths.

This is very sound advice, and acting upon it investi. ations have been made which show that it is impracticable to run 18-car trains as proposed by Mr. WELLINGTON. The Chief Engineer considers, and your committee agree with him, that 4-car trains are about as long as can be safely and quickly handled.

This does not affect the adoption of the circulating system at all, for that is merely a method of avoiding switches and an adaptation to limited space. The space in Brooklyn is not limited, and there is no reason why the present rectangular system with tail switching, modified as suggested by the chief engineer, will not answer every purpose for the Brooklyn terminus for some years to come.

The same system can also be applied to the New York terminus, and no encroachment beyond the present lines of tracks upon Centre Street, and no new lands will be needed. This modification of the present system is merely to add two more tracks parallel to the present ones, with intermediate platforms.

A double set of rails will be required on each track, to avoid the use of switches for incoming trains and to leave the tracks unbroken. Under the present system the capacity of the bridge railway is limited by the time required to stop trains, unload them, switch them into place and reload them, which is eighty seconds.

But if two trains can be loaded and unloaded simultaneously they can be despatched in half the time now required, say forty seconds, thus doubling the present capacity of the road.

The following table will show the increase:

Systems.	Intervals between trains—seconds.	Number of cars per train	Number of trains per hr.	Number of cars per hour.	Passengers carried per hr. Seated 42 in car.	Passengers carried per hr. Seated and st'd'g 126 per car.
As now operated with 3-car trains.	80	3	45	135	5,670	17,010
As now operated with 4 car trains.	80	4	45	180	7,560	22,680
Proposed plan 4 tracks and 4 cars	40	4	90	360	15,120	45,360

The cost of this improved system is estimated by the chief engineer, as follows:

Rectangular System, Four Tracks.

	N. Y. Station.	Brooklyn.	Total.
Real estate for stations,	——	——	none
Store yards for 75 cars,	——	——	$168,000
Station buildings,	$140,000	$120,000	260,000
75 new cars,	——	——	300,000
New plant and machinery,	——	——	45,000
Total.			$773,000

Your committee have no doubt that this improved rectangular system is the one to be first carried out and used until the traffic outgrows it. There is nothing new or experimental about it. Its safety has been tested by over four years' experience and the conveyance of 90,000,000 passengers in more than 700,000 trains, without accident to life or limb, with the exception of the loss of a foot by a passenger in December, 1885.

It requires slight alterations of the present machinery, and the alterations to the tracks, platforms and buildings can be carried out gradually and paid for out of the earnings of the bridge, as in the past. These changes will not interfere in the least with the traffic upon the bridge.

The safety appliances recommended by the Board of Experts can be equally well applied to this system as to the circulating system, should it be decided that they are needed.

So also a second set of overhead tracks to carry the trains of the Brooklyn elevated railways can be applied to one system as well as another if they are wanted. It now only remains to consider what shall be done in the future, when this system is outgrown.

The number of passengers carried in 1887, by three-car trains, eighty seconds apart, was 27,940,000. With the same average number of passengers per car, the yearly number that can be carried will be about 75,000,000.

According to the estimate of the Board of Experts, this number will not be reached until 1896, or seven years from now. Up to that time this proposed system will answer with an expenditure of $773,000.

It seems to your committee that it would be a more prudent and conservative course to put this system in operation and postpone the large expenditure until the traffic demands it.

In this age of inventions there is no knowing what the next seven years may produce, and if the Bridge Trustees are not hampered by a present expenditure of nearly $6,000,000, they will be ready for the best thing that offers.

We now recommend that the President and Chief Engineer be instructed:

First. To put four-car trains in operation on the present system.

Second. To prepare for the doubling of this system as above described and shown in plans *A* and *B*, and put it in operation as soon as the needs of the traffic shall demand it.

And your Terminal committee now ask to be discharged. All of which is respectfully submitted:

T. C. CLARKE, C. E.
JAMES HOWELL, Prest. } Committee.

Brooklyn, April 17.

Mr. Charles S. Higgins offered the following resolution which was unanimously adopted:

Resolved, That the foregoing report be received and adopted, and the committee discharged.

Mr. A. C. BARNES said: "I desire to know whether this plan can be extended to more than four-car trains?"

Mr. T. C. CLARKE said: "It can, but we do not think it will be necessary to have more than that number."

Mr. BARNES then offered the following, which was unanimously adopted:

Resolved, That the recommendations of the committee be and they are hereby approved, and that the President and Chief Engineer are hereby directed to proceed with the improvement as recommended.

It is stated further in the daily press, that the "investigations which show that it is impracticable to run 18-car trains" consisted of a report from the former Chief Engineer W. A. ROEBLING that to "run

trains of more than four cars over the bridge would risk its destruction or necessitate its practical rebuilding", which, if true, is a very extraordinary statement to make of such a structure, as we need not point out to engineers, since the exigencies of service may at any time require the bridge to be loaded from end to end with cars, and every well designed bridge is proportioned to carry such loads safely. We have no belief that the statement is well founded, unless the bridge is likewise too weak to carry trains of four cars. That any engineer should be willing to put his name to a statement that a bridge of his own design was safe for four car trains but was not safe for trains of 5, 10, 20 or any other number of cars is certainly a novelty in engineering literature, and one which we can hardly believe has been made.

Mr. WELLINGTON has addressed the following letter to President HOWELL, protesting against the estimates put forth as the basis for the above action as entire perversions of fact. We forbear for the present all editorial comment on the matter.

Tribune Building, NEW YORK.
April 19, 1888.

Hon. JAMES HOWELL,
President Board of Trustees New York & Brooklyn Bridge.

SIR: I herewith enter my protest against the estimates prepared without my knowledge or consent, and used as the basis for recommendations by your late Terminal Committee and subsequent action by your Board. I allege them to be grossly exaggerated, and misleading in many particulars, of which the following are the more obvious.

1. In exaggerating the cost of the larger 18-car station recommended by the Experts by including certain large items for which there is no foundation whatever, and by greatly exaggerating the cost of all the others, as specified in detail below to an aggregate amount of 327 per cent. or $3,889,290 in the obvious items, which I can now correct.

2. In suppressing all mention of the fact that the larger station was put forward only at the recommendation and request of the Board of Experts, and by them only to obtain the largest possible carrying capacity, as required by your explicit instructions to them, and that a smaller 14-car station was originally proposed by me, and is materially cheaper.

3. In suppressing all mention of the fact that it is necessary to provide for only 8-car trains by my system to equal the capacity of the system which has been so hastily adopted, with a still further resulting economy.

4. In suppressing all mention of the fact that there are large operating economies in the system recommended by the Experts, which far more than pay interest on the entire just cost of carrying out my system as proposed, as notably a complete saving of some $50,000 now spent for switching service, which will be increased by the duplicating system to fully $75,000, and a saving in cost of train and platform men, by enabling 37 men with 8-car trains to do the work of 126 with double 4-car trains, amounting to at least $53,400 a year additional. All mention of this contrast of $128,400 per year in operating expenses has been forgotten or suppressed in the figures laid before your Honorable Body. It is interest at 3 per cent. on $4,180,000.

The items of palpable and obvious exaggeration to which I now confine myself, are in detail as follows:

1. New York real estate, estimated at $1,797,750. The assessed valuation of all the land which it has been proposed to be taken, deducting $20,700 for unused parts of blocks, is $795,950, but of this $352,500 fronting on Chatham St., 44½ per cent., including all the valuable part of the *World* French's Hotel lot is taken for a street improvement only and may be built on if desired, and one-third of $128,000, $52,667, is used to widen Frankfort St., and justly assessable on property benefited. This leaves only $400,783 needed for the larger building, which at 2½ times the assessed valuation, an excessive estimate, amounts to only $1,001,960. For the 14 car station originally proposed, $244,000 assessed or $610,000 actual valuation only is taken.

2. Brooklyn real-estate; $456,500 allowed. Valuation of entire block proposed to be taken, $159,000. Only half the block is needed for the building, the rest is street improvement only. Full valuation of part needed, at 2½ times assessed, $250,000.

3. Real estate for store yards $448,000 allowed, the whole amount of which is absolutely without any shadow of justification, the land now owned by the bridge along Washington St. being far more than is required. On the other hand, the plan just adopted uses all this land for operating purposes, and yet only $168,000 is allowed in the estimate for it, for storage room which must necessarily be the same by either plan for equal traffic.

4. Station buildings: $1,100,000 for each terminus allowed, a palpable unfairness, for as cheap sheds have heretofore sufficed, and it is proposed that they shall suffice, they will equally well suffice for the system recommended by the experts. Furthermore, as only 8-car trains are needed by my system to equal the proposed system, with track room within the station for only 8 cars instead of 16, a building of less instead of greater cost will give an equal quality of accommodation. As only $260,000 are allowed for the latter no larger sum at most should be charged against the other plan and will suffice for buildings of better appearance than the present ones, good for eight or ten years, and capable at any time of enlargement, while the others are not.

5. New plant and machinery, $475,000 allowed. An exaggerated estimate even if the entire driving engines had to be renewed for 18-car trains, but the present new plant of 1,400 H. P. is ample for 14 to 16-car trains, and on a basis of 8-car trains and the same number of cars per hour no change in motive power whatever can be required. A sum, considerably under $100,000 is ample for all necessary changes of sheaves, etc.

6. New cars; 100 allowed, costing $400,000, against only 75 for the other plan. As the old stock is equally available for either this difference is palpably unfair. On the contrary, as two trains at each end are constantly out of service switching which are not needed in the circulating system, 16 cars less instead of 25 cars more would render the same service, an exaggeration of $164,000. The estimates on a true and false basis therefore compare as follows:

	Estimated.	Actual.	Exaggeration.
1. New York real estate,	$1,797,750	$1,001,960	$795,790
2. Brooklyn real estate,	456,500	250,000	206,500
3. Land for storage,	448,000	none	448,000
4. Terminal buildings,	2,200,000	300,000	1,900,000
5. New plant and machin'y	475,000	100,000	375,000
6. New cars,	400,000	236,000	164,000
	$5,777,250	$1,887,960	$3,889,290

This sum of $1,887,990 represents the utmost which can be charged up as the proper comparative cost of the 18-car station recommended by the Experts with any pretense of fairness. Interest on it at 3 per cent. is $56,639 per year, against which there is an annual saving in operating expenses of some $128,400, so that these plans will in effect cost some $70,000 a year less than nothing, whereas your Board has promulgated statements resting on the sole authority of an unsuccessful competitor before the late Board of Experts, which represent this cost as $5,777,250.

On the strength of such misstatements your Board has rejected carefully considered and fully endorsed plans, which save more than they cost to begin with and are capable of indefinite expansion, to adopt without discussion, a hastily prepared modification of a plan which your own experts emphatically condemn, which is of an admittedly temporary and non-expansive character, which costs $773,000, which gives even worse accomodation than now in many important respects, and which involves operating difficulties and dangers of the gravest character which your Board seems to have regrettable difficulty in comprehending, but which are none the less real and readily shown to experts.

Having been invited by your Board of Experts of their own motion to submit my plans to them, and having been at considerable trouble and expense to do so fully, and having been successful in that competition I consider myself plainly entitled to object to such action on the strength of *ex parte* estimates whose possible *mala fides* stands out upon the surface, although I make no such charge.

I have now therefore the honor to request, and in so far as I have the power to demand, that the plans you have just adopted, and the statements and estimates on which that action was based, be referred with the rest to your late Board of Experts and to another likewise, if you choose, feeling satisfied that three disinterested experts in transportation and engineering cannot be found in America, who will not sustain all and singular the statements of this letter in their material substance.

Respectfully submitted,
A. M. WELLINGTON.

WE learn that there is a prospect of something being done in the matter of changing the method of conducting our public works, which has been so much discussed in the past few years, and that the strong efforts made in Congress with this end in view, promise some results, if not at this session then at another. A strong sentiment is certainly developing in its favor. In this connection it may be said that the "Committee on Public Works," are in need of more money to carry on their efforts in this line. Circulars have been sent out to this effect to various engineers. Contributions should be directed to L. E. COOLEY, Secretary, 171 La Salle St., Chicago.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—At the meeting on Wednesday, April 18, J. JAMES R. CROES in the chair, the Secretary announced the deaths of Gen. Q. A. GILLMORE and Mr. GEO. EMERSON, members. The announcement was also made that the Annual Convention will be held at Milwaukee, Wis., probably during the last week of June.

The subject for the evening was "The Manufacture of Brick", in connection with which the Secretary read a letter from Mr. PURRINGTON, brick manufacturer, of Purrington, Ill. The use of the clay from the Chicago river has been proved to be impracticable on account of its wetness, but the blue clay which underlies the city can be used. Mr. Purrington's works are near Chicago, but the clay is of a different character; after excavating it by hand and breaking it up by dynamite, a steam shovel was adopted, with a dipper of 1 cu. yd. capacity. In place of dump cars, which easily get out of order or broke, he uses a dumping track. The drying tunnels are 36 ins. wide by 48 ins. high and the steam is removed by an exhaust fan. Oil is used for fuel, with satisfactory results; hot oil, hot steam and hot air are necessary for proper combustion. The Chambers stiff mud machine is used. A visitor described the works of the American Brick & Tile Works, at Phillipsburg, N. J., and referred to slate bricks, manufactured from crushed slate. They are rather more expensive than clay bricks, but the cost is offset by their advantage for high walls and structures on account of their greater compressive strength: the strength of stone is about 6,000 lbs. per sq. in.; of Philadelphia pressed brick, 3,200 lbs.; and of slate brick, 7,200 lbs. Another advantage is that they absorb much less water, and the water only penetrates to a depth of about ¼ in. Samples have been included in the tests on the resistance of different materials to percolation of water under high pressure, being made by Mr. CHURCH, Chief Engineer of the New Croton Aqueduct. Mr. CARTWRIGHT stated that brick should be soaked in water, not merely wetted, before being used. Mr. CALVIN TOMKINS described different forms of end cut off, side cut off, and moulding machines. He stated that drying by steam was better than by hot air, the latter drying the brick too quickly, causing them to check. Some experiments with oil for fuel have been made at Haverstraw, N. Y.: the results are satisfactory, as the heat is steady and under control, doing away with the loss from checked arch bricks. Mr. A. FTELEY suggested the advisability of a uniform and standard size of brick, but it was objected that it would be difficult to ensure the making of a standard size, as different clays shrink differently in burning, and the burning would also have a varying effect. Such a standard is, however, desirable and its adoption is possible.

Mr. HARRIS exhibited a piece of wood taken from an old house in New Hampshire, the wood being almost entirely eaten away by black ants. This caused some discussion on different insects destructive to wood and other material.

A letter was read from Mr. HAWKES, of Arkansas, asking for information as to methods of measurement of masonry. The contractor for a dam claims double pay for corners, and all openings to be measured as solid, with which ideas Mr. HAWKES does not agree. It was suggested that the way in which the specifications were drawn up would be of importance in individual cases.

Cincinnati Association of the American Society of Civil Engineers.—A number of members of the American Society of Civil Engineers met in Cincinnati, April 17th and organized the "Cincinnati Association of American Society of Civil Engineers", for the purpose of discussing questions of interest pertaining to the parent society. Col. WM. E. MERRILL, U. S. A., was elected President, and G. B. NICHOLSON, Secretary

Members of all classes are eligible. The aim of the organization is to bring together the Cincinnati members and such scattering ones as are within easy reach, or can make it convenient to visit Cincinnati at intervals.

Engineers' Club of Kansas City, Mo.—At the regular meeting, April 2, a letter was presented from Mr. L. E. COOLEY to the committee on National Public Works, stating that delegates from the various engineering societies would meet in Washington, April 9 and 10; it was voted to send a delegate to the meeting. The following were elected to membership: *Members*: CHAS. C. GILMAN, ROBT. GILLHAM, CHAS. S. BROWN, JAS. H. GROVE, E. J. REMILLON and FRANK ALLEN; *Associate Members*, J. B. HODODON and GEO. K. MUSSELMAN.

KENNETH ALLEN, *Secretary.*

Western Society of Engineers.—The 247th regular meeting was held April 3, Mr. C. A. STROBEL, Chairman *pro tem.*

The Secretary and Treasurer reported the finances in good condition. The Committee on "Specifications for Highway Bridges" was not ready to submit a formal report. The subject was, however, taken up and discussed at some length on the line of the last meeting. The Committee on "National Public Works" submitted the following report.

Your Committee reports that it has received from the Executive Board of the Council of Engineering Societies on National Public Works, a publication entitled, "Reorganization of National Public Works, Part I. Proposed Legislation", containing a modification of the Cullum-Breckinridge Bill for the establishment of a Bureau of Harbors and Waterways, which it is proposed to urge upon Congress. A copy of this publication has been sent to each member of the Society accompanied by a request from your Committee for a contribution of $2.00 from each member, on Society account, and as much more on individual account as each member can afford. This is in response to an assessment of one dollar per capita on the membership of the several societies by the Executive Board of the Council.

The publication referred to sets forth the whole question so fully that it is unnecessary for this committee to report upon the merits of the question. It is believed that the efforts of the Executive Board should meet with the fullest coöperation and support by this Society. Your Committee, therefore, invites discussion of the proposed legislation and the adoption of the following resolutions:

Memorial from the Western Society of Engineers to the Senate and House of Representatives of the United States of America in Congress Assembled.

WHEREAS, Our National Public Works, in their legislative and administrative conduct, have, for many years, been subject to severe and just criticism, and they are without a well considered policy or a consistent purpose, and

WHEREAS, It is believed that the careful consideration of the whole question, the formulation of a definite policy and the constitution of a specific agency for its execution, will place our public works before the people on a conceded basis of merit, will develop a definite system and secure regular appropriations, and thus rapidly develop important and necessary facilities for commerce and create new industries, therefore be it

Resolved, That the Western Society of Engineers approves the general purpose of the Cullum-Breckinridge Bill for the establishment of a Bureau of Harbors and Waterways, and believes that, in conjunction with proper changes in the Rules of Congress, it will remedy the evils now complained of.

Resolved, That the modified bill, proposed by the Executive Board of the Council of Engineering Societies, meets the approval of this Society, subject to such changes in minor details as close study may show to be desirable.

The Committee also submits the following for approval:

Resolved, That the Committee on National Public Works of this Society is authorized and instructed to promote the purpose of these resolutions.

Respectfully submitted,

L. E. COOLEY, HEIRO B. HERR, CHAS. FITZ SIMONS. } Committee on National Public Works.

Chicago, Ill., April 3, 1888.

The changes in the Rules of the House, which are intended to supplement the bill, were explained at length; also the general theory of the bill in regard to maintaining an efficient organization. After discussion, the report of the Committee was accepted and the memorial and resolution adopted.

Convention of American Water-Works Association.—The Eighth Annual Meeting of the above Association was called to order in one of the parlors of the Hollenden House, Cleveland, O., on the 17th at 11.30 A.M. by President J. T. FANNING, with Secretary J. H. DECKER, and a large number of Members and visitors in attendance. After roll call, approval of minutes of last meeting, and election of new members, Mr. DARLING, of Pawtucket, R.I., President of the New England Water Works Association, was invited to take a seat with President FANNING. In so doing President DARLING acknowledged the compliment to his society with a few appropriate remarks. An invitation of Mr. BURKE of the Lake Shore Foundry, to witness the launching of a large iron steamer, in the afternoon, together with other invitations, was referred to the Executive Committee. L. H. GARDNER, of New Orleans, asked if an opportunity could be had of witnessing the use of crude petroleum as fuel, which was replied to by Mr. C. G. FORCE, of Cleveland. An invitation was extended to the Civil Engineers' Club of Cleveland, the Water Commissioners, and similar bodies to meet with the Convention and take part in the proceedings. President FANNING then read his address on "Water Supply Treatments and Sources." A full report of the proceedings of the Convention with abstracts of the important papers read will be given in our next issue.

CONSTRUCTION NEWS.

Bridges and Canals.

Bridge Notes.—***Houlton, Me.***—An iron bridge is to be built to replace the wooden one across the Meduxnekeag river at a cost of $10,000.

Orono, Me.—The city proposes to buy the toll bridge over the Stillwater river.

Damariscotta, Me.—It is proposed to build an iron bridge across the river to Newcastle. A proposition has been made to build it for $2,000.

Boston, Mass.—The Council Committee on the Charles River bridge has been investigating the river bridges at Chicago. They will probably report in favor of the bridge, but the Navy Department claims that such a structure would be an obstruction to vessels going to the navy yard.

Norwich, Conn.—The town has decided to build the Franklin St. stone arch bridge on a slightly modified plan, doing the work by the day.

Buffalo, N. Y.—The Bridge Committee has reported in favor of bridges across Scajaquada creek at Dearborn St. and Elmwood Ave.; they will cost $23,000 and $50,000 respectively.

Camden, N. J.—The Bridge Committees of Camden and Burlington counties have declared the Pensaukin bridge unsafe and have closed it to traffic. The bridge is of iron, cost $5,200 and was only opened last summer.

Georgetown, D. C.—The new free bridge across the Potomac river was formally opened April 11.

Cleveland, O.—The city proposes to issue bonds for $85,000 for rebuilding the Seneca St. bridge.

Zanesville, O.—The bill to authorize the County Commissioners to build a bridge across the Muskingum river at the north end of Underwood St. has been passed by the Senate, but with an amendment reducing the expenditure from $75,000 to $35,000. The Commissioners have authority to build the bridge without submitting the question to public vote.

Jeffersonville, Ind.—The question of voting $75,000 to the aid of the Louisville & Jeffersonville Bridge Co., will be an important feature in the city election May 1.

Chattanooga, Tenn.—The final arrangements have been made for the construction of the Market St. bridge. The center span will be 150 ft. The bridge will be built by the Decatur Iron Bridge & Construction Co., of Decatur, Ala., and will cost about $200,000. Work will be commenced early in May and completed in 10 months.

Memphis, Tenn.—The Senate, at Washington, has passed the amended bill for the construction of a bridge across the Mississippi at Memphis. The middle span is to be not less than 700 ft. and the others not less than 600 ft.; clear headway 75 ft. The bridge is to be for railway and highway traffic.

Newport, Ky.—The Board of Engineers appointed by the Secretary of War, have approved Mr. BOUSCAREN's plans for the Ohio river bridge at this point.

Detroit, Mich.—There is considerable opposition to the projected "winter" bridge.—At a recent meeting of the Council it was decided that the contract with the Milwaukee Bridge Co. for the Belle Isle bridge should stand.

Chicago, Ill.—The Wells St. bridge has been removed to the new site at Dearborn St. Work has been commenced on the new Wells St. bridge. The masonry will be done by FitzSimons & Connel, and the Keystone Bridge Co. has the contract for the superstructure.

Grand Forks, Dak.—The bill authorizing the construction of 2 bridges across the Red river will probably be passed. The surveys have been made, and bids will be asked for soon by the City Council. The city voted 4 years ago to issue bonds for $75,000 for 2 bridges.

Randolph, Mo.—A pontoon bridge across the Missouri is proposed, similar to the one at Prairie du Chien, Wis. Mayor DEITCH, C. E., estimates the cost at $50,000

Omaha, Neb.—The only opposition to the bill authorizing the Nebraska Central Ry. Co. to bridge the Missouri at Omaha, comes from the Union Pacific Ry. Co.

Nebraska City, Neb.—It is thought the Missouri Pacific will bridge the river here; being the second railway bridge.

Hull, P. Q., Canada.—The bridge across the Gatineau river, at Gatineau point, below Hull, is expected to be constructed before next summer. It will be an iron structure and will cost $28,000. The city will pay $5,000; the Quebec Government, $10,000; the Dominion Government, $5,000; and the municipalities, $8,000.

New York State Canals.—The Assembly Committee, Albany, N. Y., has reported favorably the bill for lengthening the locks and otherwise improving the canals, but reduced the total appropriation from $1,000,000 to $530,000.

A Wisconsin Canal.—Surveys are being made for a canal from Superior, Wis., to one of the lakes on the St. Croix river. The object of the survey is to prepare estimates to be presented at the next session of the Wisconsin legislature.

Thames River Bridge.—The surveys have been made and contracts let for the New York, Providence & Boston R. R. bridge across the Thames river at New London, Conn. The draw will be 500 ft., with an opening of 225 ft. on each side of the center pier. At the middle of the river the water is 60 ft. deep, with 60 ft. of mud above bed rock. A. P. BOLLER, of New York, is the engineer. The cost will be about $1,000,000. Work will be commenced shortly, and the contract calls for the completion of the bridge by June 1889.

The Little Rock Bridge & Tunnel Co. has been incorporated to build a bridge across the Arkansas river for the St. Louis, Arkansas & Texas Ry. President, J. W. PHILLIPS, St. Louis, Mo.; Secretary, JOHN C. ENGLAND, Little Rock, Ark. Capital stock, $400,000.

Viaducts.—***Milwaukee, Wis.***—A viaduct will be built across Deer creek, at South Bay St., by the city and the Chicago & Northwestern R. R. Co. jointly. City Engineer BENZENBERG will prepare the plans and the work will be done by the North Chicago Rolling Mills Co.

Kansas City, Mo.—It is expected that work will be commenced shortly on the Fourth St. viaduct. City Engineer DONNELLY will superintend the work.

Denver, Col.—A viaduct is projected to connect the South Golden road on the west, with Colfax and Grand Aves. on the east. Plans have been prepared by R. D. HOBART, C. E.

RAILROADS.

East of Chicago.

Existing Roads.

New York & Long Island.—The company's application to the New York City Aldermen for permission to construct tunnels for rapid transit lines 60 ft. below the surface in New York City and beneath the East River to a terminus in Brooklyn has been refused. The majority report of the committee to which it was referred favored the policy of bottling up New York City on its own little island until all the available room upon it was utilized, and descanted on the policy of benefiting "the sand hills of Long Island." It is hard to conceive of a more short sighted and suicidal policy so far as increasing the real estate values of New York City is concerned. It is of a piece with the action of Philadelphia citizens toward the new Reading Terminal plans, described elsewhere in this issue.

Hereford.—This road is to be built from Cookshire, P. Q., on the International extension of the Canadian Pacific, to the New Hampshire boundary, to connect with the Upper Coös railroad, built last season from North Stratford, N. H., to the International boundary. D. WILLIAMS, of Cookshire, is Chief Engineer. Contracts for grading are to be let by May 1. The distance is about 35 miles.

Zanesville, Mt. Vernon & Marion.—The fight between this company, which is building a belt line at Zanesville, O., and the Zanesville, Newcomerstown & Cleveland, which desires terminal facilities for its proposed line at the same point, has broken out afresh, and work has been suspended till the trouble can be settled by the courts.

Boston & Providence.—The Old Colony Co. took possession of this property on April 12.

Muncie Belt.—A belt railroad is under construction at Muncie, Ind. The line will be 16 miles in length, of which 4 miles are now under construction.

Cleveland, Lorain & Wheeling.—A reconnoisance has just been made for a branch from Millport *via* Myer's Lake, to Canton and New Lisbon, O.

Pennsylvania, Poughkeepsie & New England.—It is reported that grading has begun on this road which is to run west from the Poughkeepsie bridge.

Central Vermont.—A branch is projected from Chateaugay, N. Y., on the Ogdensburgh & Lake Champlain Railroad, to Chateaugay Chasm and thence to the International boundary to connect with the St. Lawrence & Adirondack Railroad, noted last week.

Lehigh & Susquehanna.—Work has begun on a branch from Siegfried's, Pa., to Egypt, Lehigh county.

New York, Chicago & St. Louis.—The matter of constructing a branch from Stuartville to Findlay, O., will be decided at the annual meeting, to be held at Cleveland, May 2.

Evansville, Terre Haute & Indianapolis.—It is currently reported that this company is behind the Indianapolis & Southwestern enterprise, whose incorporation was noted last week. Surveys are now in progress.

Cincinnati, Hamilton & Dayton.—Contracts have been let for the extension from McComb's to Findlay, O., a distance of 10 miles.

New Projects and Surveys.

Tilton & Belmont.—

BELMONT, N. H., April 18, 1888.

EDITOR ENGINEERING NEWS:

Our road is to be six miles long, running through the towns of Belmont and Tilton. The line has been surveyed, most of the right of way deeds are taken, and contracts will be let sometime this spring the line to be completed this season. There will be one bridge 495 ft. long. The Concord and Boston, Concord & Montreal Railroads are back of the enterprise. CHAS. E. TILTON, of Tilton, N. H., is President, and C. O. FOSS, of Concord, is Chief Engineer.

EDWIN C. BEAN, *Secretary.*

Castine & Bangor.—

BANGOR, Me., April 12, 1888.

EDITOR ENGINEERING NEWS:

The surveys are all complete for the Castine & Bangor railroad from Bangor through Brewer, Holden, Dedham, Bucksport, Orland and Penobscot to Castine Harbor. Work is generally light and maximum grades are 1 per cent. There will be a 1,100 ft. iron bridge over the Penobscot river at Bangor. The road is projected in the interest of eastern Maine, Bangor being a commercial center and Castine a seaport always open. The Canadian Pacific and Bangor & Piscataquis will interchange business with us. The right of way is nearly secured, the sale of bonds is meeting with favorable consideration, and contracts for construction will probably be let some time this spring. JAS. ADAMS, of Bangor, is President.

The Northern Maine Railroad, from Presque Isle to Mattawamkeag, will probably be commenced this summer.

A. M. DEVEREAUX, *General Manager C. & B. R. R.*

Lantern Hill.—The Silex mine and works in the town of North Stonington, Ct., have been purchased by New York City capitalists, and a reconnoisance was recently made for a railroad from the works west to the Thames river.

Haverhill & Lawrence.—This Massachusetts project has been revived and is endeavoring to obtain right of way through Lawrence. The right of way has been secured through Bradford and Methuen. It is stated that the line will eventually be continued to Boston, securing an entrance to that city over the Fitchburg tracks. C. E. WIGGIN and GEO. A. HALL, of Haverhill, are interested.

Wilkesbarre & Williamsport.—Two corps of engineers are at work on the survey for a railroad between these Pennsylvania cities. The proposed route is *via* Harvey's Lake and Plymouth Junction.

SOUTHERN

Existing Roads

Buena Vista & Ellaville.—

AMERICUS, Ga., April 12, 1888.

EDITOR ENGINEERING NEWS:

Our line formerly ran from Buena Vista to Andersonville, Ga., *via* La Crosse. From La Crosse to Andersonville the distance was 6 miles, and this end of 6 miles was, last year, torn up and the line changed from La Crosse to Americus instead. The distance from La Crosse to Americus is 9 miles, making a difference of 3 miles only in track laid last year over the length of the original line. Preliminary surveys are about completed and engineers are now locating the extension of the road from Buena Vista to Columbus, Ga., 35 miles. When this is built, which will be at once, it supplies the only missing link in a new through line between Kansas City and Jacksonville, Fla., *via* the new Columbus & Western road of the Central Railroad & Banking Company, of Georgia.

URIAH B. HARBOLD, *President.*

Georgia Pacific.—The town of Winona, Miss., has voted $65,000 aid to the extension from Columbus to Greenville, Miss. Other towns have the matter under consideration. The company has offered its stockholders the privilege of subscribing to the loan of $2,520,000 for the completion of the line and there is little doubt that the extension will be pushed through this season.

Kanawha & Ohio.—About 100 men are at work on the 5 mile extension let on April 9, to J. N. Lamkin. It is stated that the line will be pushed on south about 30 miles this season.

Central R. R. of Georgia.—President ALEXANDER is reported as saying that his recent visit to New York completed the arrangements necessary for the building of the extensions of this system. The line from Eden to Americus and the extension from Buena Vista to Columbus will be the first to be constructed. A line from Milledgeville to Tenille is also contemplated.

Louisville, New Orleans & Texas.—A branch is said to be under consideration from Huntington, Miss., northwest about 50 miles. The report that a ferry transfer and incline was to be established at Helena, Ark., proves to be without foundation.

Ohio River.—Through trains are now running over the new bridge across the Great Kanawha river at Point Pleasant, W. Va.

West Virginia Central.—About 800 hands are at work on the Cheat river extension from Thomas to Leadsville in Randolph county, W. Va.

Troy & Tiptonville.—Grading is about finished on this road between Rives and Troy, Tenn., a distance of 6 miles.

Georgia, Carolina & Northern.—This road is complete from Monroe, N. C., to the South Carolina State line and a short section has been opened for traffic.

Cape Fear & Yadkin Valley.—The preliminary survey is nearly completed from Fayetteville to Wilmington, N. C., 80 miles. On the Stokesdale and Madison branch about 5 miles are graded, and it is thought the whole line will be ready for the rails by Aug. 1.

Maysville & Big Sandy.—Tracklaying is being pushed on the gap between Maysville and Ashland. Some trouble has arisen with the contractors for masonry and the company may be delayed by legal proceedings from gaining possession of its line.

South Atlantic & Ohio.—The 25 miles still to be built on this Virginia road are to be put under contract at once. This will bring the road to Big Stone Gap. C. H. JONES of Bristol, Tenn., is Chief Engineer.

Mobile & Dauphin Island.—It is not known when work will be resumed on this Alabama road. A great amount of dredging will be required before the piers at Dauphin Island will be accessible to any but vessels of light draft.

Lynchburg & Durham.—Grading is nearly finished on the first 10 miles from Lynchburg, Va., to Rustburg. The grading for the next 23 miles to Staunton river in Campbell county and for 26 miles in Halifax county has been let. The contracts for 10 miles in Durham county, N. C., and for 10 miles in Person county, N. C., will be let very soon. PETER J. OTEY of Lynchburg is President.

New Projects and Surveys.

Decatur & Moulton Heights.—

DECATUR, Ala., April 16, 1888.

EDITOR ENGINEERING NEWS:

The Decatur & Moulton Heights Railroad is to be a narrow gauge dummy line to run from Decatur to Trinity, about 8 miles. The road is projected in the interest of land companies and the cash for building the line and the right of way have been secured. Surveys will begin immediately and contracts for construction will be let very soon. J. F. SCOTT is President and P. JONES is Chief Engineer.

W. E. FORREST, *General Manager.*

Eastern Nashville.—The city of Nashville, Tenn., seems to have a dummy railroad fever. The latest project is the Eastern Railroad, chartered by J. E. HARRIS, CHAS. T. COLE, THOS. S. WEAVER and others.

Charleston & Gauley Bridge Railway.—The promoters of this enterprise at Charleston, W. Va., are securing right of way for their proposed line. EDWARD B. KNIGHT is interested.

Darlington & Hartsville.—A project is being agitated at Darlington, S. C., for the construction of a railroad to Hartsville, about 15 miles.

Mobile & Southeast Alabama.—Incorporated in Alabama by S. D. BROWN of Mobile and others, to build a railroad from a point on the line of the Mobile & Montgomery Railroad near Brewton, through five counties in Alabama to Abbeville, Henry county.

Decatur, Chesapeake & New Orleans.—The city of Shelbyville, Tenn., has nearly completed its subscription of $40,000 to the stock of this company, and it is stated that grading will begin at once. JOSIAH FLOURNOY of Decatur, Ala., is Chief Engineer.

Madison & Southeastern.—The charter of this company is pending before the Kentucky Legislature. The projected line is to run from Madison, Ind., south through Newcastle, Henry Co. Ky.

Springfield & Adairsville.—A railroad project is being agitated for a line from Springfield, Tenn., to Adairsville, Ky., about 12 miles. J. W. MOORES of Bevier, Ky., is interested.

Missouri, Tennessee & Georgia.—The company which was organized at Humboldt, Tenn., about a year ago, is reported to be now making some effort toward constructing a line from a point on the Mississippi river opposite New Madrid, Mo. to Humboldt, about 50 miles. C. H. FERREL of Humboldt is Treasurer.

THE NORTHWEST.

Existing Roads.

Duluth, Huron & Denver.—This company was incorporated Feb. 15, 1886 by JOHN P. CONKEY, Dubuque Ia.; E. P. CALDWELL, CHARLES M. HANSON, and LESLIE DURLEY, Huron, Dak.; FRED T. DAY, Milwaukee, Wis.; T. C. DAY, Indianapolis, Ind.; C. E. MAHLE, FRANKLIN C. PLATT, Waterloo, Ia.; E. J. HODGSON, St. Paul, Minn. with a capital stock of $10,000,000 and much noise was made during the season of 1887 over the great trunk line which the company was building. Farmers all along the route were induced to work on the grading and in this way a good deal of earth was moved all along the line from Sauk Center, Minn., east about 100 miles, which was paid for in promises. According to present advices the assets of the company consist of a stove, an office desk, and $1.50 in cash, and it is stated that the whilom promotors of the enterprise have preferred to leave the fruits of their labors for others to reap rather than face the crowds of irate workmen demanding their pay.

The foregoing episode is of a class very familiar in the annals of railway building and such cases probably will continue to recur until people grow wise enough not to be duped by promoters of railway enterprises of the wildcat order.

Chicago & Eastern Illinois.—As announced in last week's contracting records, the grading is to begin at once on the extension from Momence, Ill., to Goodland, Ind., to connect with the Chicago & Indiana Coal R. R.

Wabash.—It is reported that the company has just made arrangements for the interchange of through traffic with the Ontario Dispatch and the Rome, Watertown & Ogdensburg.

Grand Trunk.—Premier GREENWAY of Manitoba is reported as stating that from various interviews with General Manager HICKSON he concludes that the company will build to Sault Ste. Marie at an early date. It is also given out that the Grand Trunk will reach Winnipeg over the St. Paul, Minneapolis & Manitoba tracks, though it is not stated how they are to reach them over the present intervening space of several hundred miles.

Illinois Central.—The company has filed a mortgage for $15,000,000 to the United States Trust Company, of New York City, to secure a loan for extensions and equipment.

Chicago, Burlington & Quincy.—The following estimate of the total cost of the strike is given by the Chicago *Tribune*:

"Loss of wages, 'Q' Road, $306,135; pay-roll of brotherhood, $159,450; Grievance Committees' loss of wages, $30,870; Grievance Committees' expense account, $22,050; non-union men subsidized, $20,000; expenses of headquarters, $3,375; Santa Fé and other strikes, $24,700; cost of switchmen's strike, $25,000; miscellaneous, $10,000; total, $601,580.

"Of the cost to the Burlington Company the following estimates are made: Loss in traffic receipts, $1,800,000; special police protection, $180,000; cost of engaging new men, $50,000; damage to property, $50,000; miscellaneous, $20,000; total, $2,100,000. These are all direct losses, affecting one or the other of the contestants in the great strike. There are indirect losses to the commercial community scattered through the whole ramifications of the "Q" system in several States. Besides these, hundreds of minor employes have been thrown out of work."

The annual report for 1887 makes the following showing:

Gross earnings	$27,576,078
Increase over previous year	847,670
Expenses	16,097,913
Increase over previous year	1,609,230
Net earnings	11,478,165
Decrease over previous year	758,560
Total fixed charges	5,286,681
Total funded debt	91,266,467
Increase over previous year	11,727,000
Expended in construction and equipment	15,131,542

New Projects and Surveys.

Sioux City Rapid Transit.—This company has been incorporated to build an elevated railroad, at Sioux City, Ia. E. C. PETERS is President.

Lenox & Avondale.—This company has been chartered by PERRY H. SMITH, JOHN S. BURKE and others of Chicago to build a short railroad from New Lenox, Will county, to Avondale, Du Page county.

Winnipeg & Southeastern.—This company which is just being organized will apply to the Manitoba legislature for a charter. The line is to run from Winnipeg to the boundary to connect with the proposed Duluth & Winnipeg. Among the promoters of the enterprise are J. H. ASHDOWN, W. F. ALLOWAY, JOHN B. MATHER, A. MCDONALD, E. C. EGAN and W. R. SINCLAIR, of Winnipeg.

Ontario, Manitoba & Western.—This enterprise is said to be regarded with disfavor at Winnipeg where an outlet to the States is desired rather than shipments through Canada.

Nebraska Central.—A bill is pending in Congress giving this company a charter for a bridge across the Missouri river at Omaha. This is the company which made some surveys from Omaha, northwest last season, and was currently reported to be backed by the Chicago, Milwaukee & St. Paul.

THE SOUTHWEST.

Existing Roads.

San Antonio & Aransas Pass.—The city of Austin, Tex., is jubilant over the prospects of securing the extension of this system. The subsidy asked by the company has been nearly raised, and it is expected that the company will begin work on the line at once. The tracklaying on the Skidmore branch is reported finished, and grading is in progress on the Houston extension.

Kansas City & Pacific.—The city of Paola, Kan., has voted aid to this company for its extension from Selma to Paola, and the work will probably be pushed forward at once.

Denver, Texas & Fort Worth.—The branch in the Texas Panhandle from Washburn to Panhandle City, the present terminus of the Atchison, Topeka & Santa Fé's Kiowa extension, has been completed. The line is 16 miles in length.

Arkansas Midland.—It is reported that work will soon begin on the extension from Clarendon to Little Rock, Ark., a distance of about 40 miles. A. H. JOHNSON, of Helena, is President and General Manager. It

is reported that an effort is to be made to secure a charter for a bridge across the Mississippi at Helena.

Fort Worth & Rio Grande.—At the recent annual meeting H. B. HOLLINS and W. H. BEERS, of New York City, E. E. DENNISTON of Philadelphia, and E. P. ALEXANDER, President of the Georgia Central were among the directors chosen. B. B. PADDOCK of Fort Worth was elected President and C. L. HORTON, of New York City, Treasurer.

Missouri Pacific.—According to the Kansas City *Times*, the company contemplates the construction of lines from Carthage, Mo., to Bald Knob, Ark., from Bagnel, Mo., to Carthage, and from Bagnel to Nevada, Mo.——On the Lexington, Boonville & Jefferson City line in Missouri, the tracklayers are making rapid progress toward Boonville. Right of way difficulties still delay work on the eastern division between Boonville and Jefferson City. Reports are in circulation that the Chicago & Alton has made a traffic agreement with the Missouri Pacific, and will divert its southwestern traffic to that system as far as possible.

Kansas City, Fort Scott & Gulf.—On the Current river extension from Willow Springs, Mo., east, track was laid for a distance of 29 miles during last year and has now been extended 85 miles farther. The total length of the branch is 81 miles.——The bill authorizing the construction of a bridge across the Mississippi river at Memphis, Tenn., has passed both houses of Congress and only awaits the approval of the President. The bridge will be a combined highway and railroad bridge and it is expected that work will begin very soon on the foundations.——The company's annual report for 1887 shows: Gross earnings, $2,732,203, an increase of $192,865 over 1886. Operating expenses were $1,661,174, an increase of $185,644, making the net earnings, $1,071,032 an increase of $7,221.

St. Louis, Arkansas & Texas.—It is rumored that the company contemplates extensions to Dallas and Austin, Tex.

Kansas City, Wyandotte & Northwestern.—It is reported that surveys are in progress for branches from Tonganoxie, to Lawrence and Topeka. A line is also proposed from Valley Falls west through Jefferson, Jackson and Pottawatomie counties.

New Projects and Surveys.

Leavenworth & Denver Short Line.—One of the preposterous stories in reference to railway extensions which are originated by no one knows who, and are palpably absurd on their face, has been going the rounds of the daily press the past week. The following, is the version given by the New York *Times*:

"CHICAGO, April 15.—It is announced upon very good authority that the Chicago, Milwaukee and St. Paul Company is behind the proposed Leavenworth & Denver Short Line, which is just now exciting a great deal of interest among the business men of Denver and points along the proposed line. It is known that the St. Paul has purchased 1,950 acres of water front at Oakland, and that it has quietly secured right of way for a distance of 850 miles from Oakland, through Stanton and Lathrop. The direction of the route selected is eastward from the Pacific coast to Salt Lake City, and as the expressed intention of the people having in charge the Leavenworth & Denver Short Line is to construct a line to Denver, and then westward through the mountains to Salt Lake City, it is very easy to believe that the St. Paul is interested in the new enterprise."

"The company has an independent line to Kansas City and is anxious for Western and Southwestern business. It would be an easy matter to extend this line to Leavenworth and thence westward to Denver, especially in view of the practical certainty of receiving aid from every county along the route. The statement is made that the Denver people propose to tunnel the mountains and push the new line to Salt Lake. When these disjointed facts are put together and combined with the St. Paul's recent purchase of water frontage at Oakland and the right of way eastward to Salt Lake City, it rounds out a colossal but entirely feasible scheme, behind which looms up the Chicago, Milwaukee and St. Paul, striking for the Pacific coast."

It is not necessary to inform anyone conversant with the affairs of the Chicago, Milwaukee & St. Paul that the managers of the company are not at all likely to back up an enterprise of so little real merit as the proposed Leavenworth & Denver Short Line, which has been originated and furthered only for the purpose of booming the city of Leavenworth, and whose prospects as an investment do not permit any probability that its promoters can secure capital for its construction. The assertion that the Chicago, Milwaukee & St. Paul has purchased land at Oakland, Cal., and secured right of way for a distance of 850 miles eastward from that point do not need the contradiction which officers of the company have given them to assure any well informed person of their falsity.

Recently the Leavenworth projectors of this road have interested citizens of Denver in their enterprise and they have incorporated the Colorado & California Short Line Railway with DONALD FLETCHER of Denver as President and H. M. ALLER of Leavenworth as General Manager. Doubtless the company will make surveys about which there will be considerable noise, for the real object of its promoters is only to advertise the real estate of Leavenworth, Denver and Salt Lake. The enterprise itself if it had no other weakness, would fall by its own weight.

White Oaks.—A subsidy of $100,000 has been raised for the company at El Paso, Tex.

Dallas, Archer & Pacific.—It is reported that this projected line 140 miles in length which was surveyed a year ago from Dallas, Tex., northwest, is to be revived GEO. T. ALFORD of Dallas was at the head of the enterprise.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Chicago, Rock Island & Pacific.—Grading is in progress at various points on the extension to Colorado Springs, and the whole line is to be completed by Nov. 1. Streeter & Bradbury of Denver have the contract for one of the western divisions, and have begun work with headquarters at Granger, Col.

Calabasas, Tucson & Northwest.—This Arizona company has marketed its bonds, and has let the contracts for construction to Belden & McTighe. Rails have been purchased and 60 miles will be completed this year. Among the officers are CHAS. DODGE, H. D. FAULKNER, EDWARD BENEDICT and STEPHEN H. THAYER.

Mexican Central.—By latest reports from the tracklayers on the Guadalajara extension it is probable that by the time this issue of ENGINEERING NEWS reaches its readers, the rails will be laid to Guadalajara, making the total length of the branch 161 miles, of which about 100 miles have been laid this year. The company has not intended to complete the line from Guadalajara to the Pacific coast at present, but the merchants of Guadalajara and the Governor of the State of Colima have offered to give large bonuses in aid of the extension if made at once, and it is possible that the line may be built on this year to Mazatlan, San Blas or Colima.

Seattle, Lake Shore & Eastern.—The citizens of Spokane Falls, W. T., have subscribed $175,000 to the stock of this company and the company has agreed to begin work by May 1, on the grading of their road from Spokane Falls west. At least 40 miles of this division will be completed in time to move the grain crops of the present season.

Eureka Flat & Walla Walla.—The subsidy asked for this Washington Territory line has been secured, and G. W. HUNT, who is at the head of the enterprise has begun work on the grading. He intends to have the whole line ready for the rails by June 15.

Union Pacific.—Under the head of "The Greatest Railroad Undertaking Ever Known," the Denver *Republican* says:

"A large party of Union Pacific surveyors are in the vicinity of Como working on what is commonly supposed to be a line for a railroad rom that place in a nearly direct line across Mosquito pass and down into Leadville."

"To one familiar with the apparent impossibility of crossing Mosquito pass with a railroad it would seem that the only practical course for the Union Pacific will be to bore a long tunnel. In any event, if constructed, the road will be unparalelled for engineering enterprise by any like project ever attempted in America. Mosquito pass is usually closed with snow from September to May. On the west side the mountain is almost precipitous for 4,000 ft. The summit of the pass is 13,000 ft. high."

"The new road would cut off about forty miles of the present South Park line. Now the road runs from Como in a northwest direction to Frisco, and then turns again directly south into Leadville. By the new line the general course of the road from Denver will be southwest. The view and scenery from Mosquito pass would be the grandest afforded by any railroad on the continent. It is a great undertaking, but, if possible of accomplishment it would place the South Park far at end of all competitors on distance. The route over Mosquito pass was talked of in 1879, but Major Evans, the chief engineer of the Union Pacific, dissuaded the company from the project. He did not believe it practicable. Since then, however, greater feats of engineering have been successful than Major Evans dreamed of. The route may be now deemed possible."

The writer of the above fails to inform us how the Union Pacific is to derive any benefit from this "greatest railroad undertaking" at all commensurate with the expense, and we are therefore inclined to regard the report with incredulity. The Union Pacific is certainly not in a condition to build extensions or tunnels for any other reason than because they will pay.

Southern Pacific.—Tracklaying has been completed on the Willows & Mendocino County branch, 17 miles in length, and the tracklayers are at work on the Capay Valley line.

New Projects and Surveys.

Willamette Bridge & Railway.—This company has contracted to build a suburban railway at Portland, Oregon, to be completed July 24.

Ellensburg, Big Bend & Salmon River Transportation Company.—The survey of this road was begun at Ellensburg, Wash. Ter., on April 11. The line will run from Ellensburg to the Columbia river about 30 miles, and is to be completed in 90 days.

Midland and Kaweah River & Giant Forest.—These two companies have been incorporated in California to build a railroad about 35 miles in length in Tulare county. W. S. BURTON of Visalia, WM. B. LAKE and M. S. EISNER of San Francisco, and JAS. A. WATERMAN of Fresno are among the incorporated.

Contracting.

The Laidlaw & Dunn Co., of Cincinnati O., manufacturing pumping and other machinery, pipe, and railroad and general supplies, is extending its trade. A large shipment of machinery was made recently to Sydney, Australia, and a large duplex pump has been sold to Mr. Mashima, of Yokohama, Japan, who is in this country buying machinery. The company has also contracted to furnish the Commissioners of the Centennial Exposition of the Ohio Valley and Central States, with pipe, fittings and valves for fitting up the engines, boilers, etc. It has also the contract for all the material for the steam and water heating in the new Chamber of Commerce, Cincinnati.

Curbing.—The following proposals for all curbing for the present year have been received by the Board of Public Works, Omaha, Neb.: McConnell & Orr, Berea sandstone, 80 cts., Joliet limestone, 77½ cts. J. E. Riley, Sioux Falls granite, $1 15, Colorado sandstone, 89 cts, Berea sandstone, 73 cts., Mankato limestone, 76½ cts. E. J. Brunner, Berea sandstone, 73½ cts., Joliet limestone, 73 cts. J. Fox & Co., Colorado sandstone, 89½ cts., Mankato limestone, 74½ cts. Nebraska & Colorado Sandstone Co., Colorado sandstone, 85 cts., Berea sandstone, 77 cts. Hugh Murphy, Colorado sandstone, 84 cts., Mankato limestone, 73 cts. M. Smiley, Colorado sandstone, 95½ cts., Berea sandstone, 73½ cts., Mankato limestone, 80 cts.

Paving.—Proposals for paving were opened April 9 by O. N. GARDNER, City Engineer, Lincoln, Neb. The bidders were, Stout & Buckstaff, J. E. Stockwell, John Fitzgerald, Landham & McNair, Pat McGeer, Tom Price, C. C. Bells and Pat Mears, of Lincoln; J. E. Reilly and Hugh Murphy, of Omaha; A. J. M. Bean & Co., McAdams & Amberg, and J. B. Smith & Co., of Chicago, Ill.; Barber Asphalt Paving Co., Washington, D. C.; and Kelly & O'Shea, Winnipeg, Man.——The prices ranged as follows: Sioux Falls granite on sand, on broken stone and sand, and on concrete, $2.60 to $2.65, $2.95 to $3.09, and $3.12 to $3.25 per sq. yd. Colorado sandstone on similar foundations, $2.57 to $2.61, $1.97 to $3.05, and $3.10 to $3.20. Cedar blocks on similar foundations, $1.37 to $1.67, $1.45 to $1.65½, and $1.62 to $1.93½. Brick on similar foundations, $1.75 to $1.82½, $2.10 to $2.23½, and $2.25 to $2.73. Sheet asphaltum, 5 and 10 years, guarantee, $2.95 and $3.45. Curbing, 4 × 20 in. and 5 × 20 in., 64½ to 84 cts. and 76 to 92 cts. Gutter stone, 5 × 12-in., 38 to 75 cts. Crosswalks, 52 to 78 cts. Drain tile, 4-in., 4 to 8 cts. Grading, 18 to 32 cts. per cu. yd. Concrete, $5.50 to $6.49 per cu. yd. Sand, $1.20 to $1.50 per cu. yd. Broken stone, $2.50 to $3.25 per cu. yd. Gravel, 30 cts. to $3.65 per cu. yd. Paving cement, 14 to 22 cts. per sq. yd.——The work includes 238,459 sq. yds. of paving; 90.190 ft. each of 4 × 20-in. and 5 × 20-in curbing; 422 corner blocks; 139,283 cu. yds. grading; 1,000 cu. yds. concrete; 1,000 cu. yds. sand; 500 cu. yds. broken stone.

Bridge Contracts.—*Churchville, N. Y.*—The following proposals have been received by the Highway Commissioners of the town of Riga for an iron bridge across Black creek at Churchville: Dean & Westbrook, New York, $5,450 for 2 spans, $6,200 for 1 span; Borling Bridge Co., $5,846; Massillon Bridge Co., Massillon, O., $6,825; Groton Bridge Co., Groton, N. Y., $7,075. The contract was awarded to Dean & Westbrook for a 1 span bridge.

Baltimore Co., Md.—W. H. SHIPLEY, Bridge Superintendent, Baltimore, Md., has awarded the contract for the bridge at Sparkes Station to the Wrought Iron Bridge Co., of Canton, O., for $4,472.

Poast Town., O.—The following proposals for the superstructure of the bridge over the Great Miami river have been received by the County Commissioners: Pittsburg Bridge Co., Pittsburg, Pa., $24,000. Smith Bridge Co., Toledo, O., 6 plans from $15,400 to $18,000. Wrought Iron Bridge Co., Canton, O., 3 plans, $51, $52.90 and $52 per lin. ft. Groton Bridge Co., Groton, N. Y., $20,800 and $22,090. P. E. Lane, Chicago, Ill., $14,827. Variety Iron Works Co., Cleveland, O., $19,900. Indiana Bridge Co., Muncie, Ind., $17,999. Penn Bridge Co. Beaver Falls, Pa., $18,515. Massillon Bridge Co., Massillon, O., $20,000 and $18,500. Berlin Iron Bridge Co., Binghamton, N. Y., $21,500 and $20,000; Milwaukee Bridge & Iron Works, Milwaukee, Wis., $14,899; Mt. Vernon Bridge Works, Mt. Vernon, O., $18,900, $19,245 and $19,268; Columbia Bridge Co., Dayton, O., $45.50 per lin. ft.; King Iron Bridge & Mfg. Co., Cleveland, O. $14,675, $15,404, $16,575, $16,925, $16,573, for iron joists $1,350 additional; Missouri Valley Bridge Works, Leavenworth Kan., $15,775.

Memphis, Tenn.—The Motherwell Bridge Co., o Ohio, has been awarded the contract for a bridge over the Loosahatchie river, on the Arlington and Covington road, for $5,997.

Kalamazoo, Mich.—The contract for the Kalamazoo river bridge has been awarded to the Wrought Iron Bridge Co., of Canton, O., for $14,100.

Minneapolis, Minn.—The contract for the bridge across Bassetts creek, at 5th Ave. north, has been awarded to R. M. Douglas for $2,289.60.

Water Pipe.—The following proposals for cast-iron pipe and specials were opened April 16 by the Executive Board, Rochester, N. Y.: Thos. J. Neville, Secretary:

	Donaldson Iron Co. Emaus, Pa.		Mellert Foundry Reading, Pa.		Warren Foundry & Machine Co. New York.		Buffalo Pipe Co. Buffalo N. Y.		R. D. Wood & Co. Philadelphia, Pa.		Detroit Pipe & Foundry Co. Detroit, Mich.		Jackson & Woodin Mfg. Co. Berwick, Pa.	
	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
5 net tons of 10-in. straight pipe.	$26.55	$ 131.75	$27.00	$ 135.00	$27.80	$ 139.00	$27.00	$ 135.00	$28.35	$ 141.75	$29.70	$ 148.50	$29.38	$ 146.90
45 " 8-in. "	26.55	1,194.75	27.00	1,215.00	27.80	1,251.00	28.00	1,260.00	28.35	1,275.75	29.70	1,336.50	30.28	1,362.60
190 " 6-in. "	26.55	5,044.50	27.20	5,168.00	27.80	5,282.00	28.50	5,415.00	28.35	5,386.50	29.70	5,643.00	30.28	5,753.20
35 " 4-in. "	26.55	929.25	28.40	994.00	27.80	973.00	28.50	997.50	28.35	992.25	29.70	1,039.50	32.96	1,153.60
4,000 lbs. of specials	.2¼	315.00	.2¾	350.00	.2⅞	341.02	.2½	350.00	.2¾	367.50	.2⅞	336.00	.2¾	367.50
Totals		$7,616.25		$7,862.00		$7,986.02		$8,157.50		$8,163.75		$8,503.50		$8,783.80

Sewer.—The folowing proposals for the construction of sewers have been received by F. Floyd Weld, City Engineer, Waterbury, Conn. The contract was awarded to C. W. Blakeslee & Sons.

Bidders.	45-in. brick sewer, 160 lin. ft.	36 in. brick sewer, 380 lin. ft.	30-in. vit. pipe, 2,600 lin. ft.	18-in. vit. pipe, 1,100 lin. ft.	12-in. vit. pipe, 120 lin. ft.	8-in. vit. pipe, 350 lin. ft.	24-in. cast-iron pipe, 12 lin. ft.	20-in. cast-iron pipe, 600 lin. ft.	16 in. cast-iron pipe, 70 lin. ft.	12-in. cast-iron pipe, 70 lin. ft.	10-in. cast-iron pipe, 48 lin. ft.	6-in. cast-iron pipe, 120 lin. ft.	30 manholes.	1 outfall chamber.	1 terminal chamber.	1 well.	Total.
R. L. Bronson & C. E. Judd, Waterbury, Conn.	$ 8.82	$ 6.86	$4.71	$1.25	$3.37	$3.03	$6.75	$6.25	$5.75	$5.25	$5.00	$1.75	$35.00	$477.00	$168.60	$221.00	$33,958.90
George H. Byrnes, Waterbury, Conn.	7.40	6.25	3.65	4.15	1.40	1.26	4.45	6.20	4.50	1.60	1.50	2.30	60.00	260.00	1500.00	400.00	29,949.90
Metropolitan Constr'tion Co., Boston, Mass.	10.09	10.19	3.25	2.79	1.59	0.83	5.99	5.11	3.07	2.39	2.19	1.91	41.00	447.00	179.00	305.00	26,019.40
Theodore A. Madden, Bridgeport, Conn.	9.00	9.50	3.00	2.50	1.50	1.25	6.00	5.00	4.00	3.00	2.50	1.75	65.00	610.00	150.00	300.00	25,414.50
C. W. Blakeslee & Sons, New Haven, Conn.	7.90	8.40	2.85	2.35	1.90	1.00	5.20	4.25	2.95	2.25	1.95	1.75	50.00	725.00	250.00	460.00	23,471.00

The United States Fire Clay Co., of Cleveland, O., manufacturing salt glazed pipe, architectural clay work, and all fire clay products, has issued a new illustrated catalogue and price list. It contains a table of capacity of different sizes of pipe, directions for laying and a number of opinions of engineers on sewer pipe.

Sewerage System.—The following proposals for the construction of a separate storm sewerage system in Storm Sewer District No. 1 were opened April 5, by O. N. Gardner, City Engineer, Lincoln, Neb. The contract was awarded to G. S. Miller, and the work is to be completed by July 1. The prices for sewers include all excavation, refilling and junctions, complete.

	Geo. S. Miller, Council Bluffs, Ia.	Stout & McDonald, Lincoln, Neb.	Everson & Liddle, Lockport, N. Y.	Hugh Murphy, Omaha, Neb.	Mount & Griffin, Omaha, Neb.
5 ft. brick sewer, per lin. ft.	$6.50	$6.35	$6.40	$6.36	$7.28
4¼ ft. " " " "	5.50	5.85	5.72	5 91	7.10
3½ " " " "	4 35	4.45	4.53	4.56	4.08
2¾ " " " "	3.58	3.65	3.72	3 66	3.84
21 in. pipe " " "	1.60	1.47	1.56	1.96	1.87
15 " " " "	.90	1.10	1.04	.81	1.04
12 in. catch basin pipe, complete, per lin. ft.	.62	.93	.92	.61	.73
Man-holes, complete, per vertical foot	3.50	4.35	4.00	3 06¾	4 40
Catch basins, complete, per vertical foot	3 50	4.10	3.50	3.31½	4.50
Grading, per cu. yd	.50	.30	.50	.50	.30
Gravel in work, per cu. yd	2.50	2.65	4.00	3 50	4.00
Concrete in work, per cu. yd	10.00	6.00	7.50	7.00	2.00
Brick masonry, per 1,000 brick in wall	18.00	19.35	22.00	15.00	24.00
Oak lumber left in work, per 1,000 ft. B. M.	36.00	35.00	45.00	40.00	45.00
Pine lumber left in work, per 1,000 ft. B. M.	28.00	25.00	30 00	30.00	25.00
Cast-iron for man-holes and catch basins, in place, per lb.	.03	.03	.03	.03	.01
Wrought-iron man-hole steps, complete, per piece	.50	.55	.50	.05	.25
Totals.	$27.033.89	$28.222.69	$28,283.39	$28,875.67	$31.428.82

River Improvement.—The following proposals for materials to be used in the improvement of the Muskingum river, Ohio, have been received by Lt. Col. W. E Merrill, U. S. Engineer Office, Zanesville, O.: Lt. Lansing H. Beach, Engineer in charge: *Cement*, (Portland): T. B. Townsend & Co., Zanesville, $2.70 per bbl., $2.700 for Columbus brand, also $3.34, $3,340; John W. Dickinson, Chicago, $2.75, $2,750; Sinclair & Babson, New York, $3.06, $3,060; Howard Fleming, New York, $3.10, $3,100. Gibbs and Black Cross brands: John Mueller, Lockland, O., $3 30, $3,300, K. B. & S. brand.—(Natural): James B. Speed, Louisville, Ky., $1.30 per bbl., $650; John Mueller, $1.35, $675; T. B. Townsend & Co., $1.40, $700; Howard Fleming, New York, $1.80, $900.

Timber.—Joshua R. King, Belpre, O., $19 per M., $9,500; John F. King, Belpre, O., $20, $10,000; Irish & Warner, Marietta, O., $21.23, $10,615; Hayes Bros. & Woodruff, Vincent, O., $21.50, $10,750; J. R. Gorby, Belle Valley, O., half the quantity, $21.50, $5,375; Marietta Chair Co., Marietta, O., $17 and $24, $10,873; S. H. Stinchcomb, Malta, O., $21.75, $10,875; Patterson, Burgess & Co., Zanesville, $22,90, $11,450; W. H. Taylor, Duncan's Falls, O., half the quantity, $27, $6,750.

Dimension Stone.—E. M. Ayers, Zanesville, O., $2.69, $2,690; T. B. Townsend & Co., Zanesville, $2.98, $2,980; Blake & Gormley, Luke Chute, O., $2.99, $2,990; Williams & Foute, Eagleport, O., $3.25, $3,250; E. B. Henderson & Son, Marietta, O., $3.33, $3,330; Oliver Demster & Jos. Garrett, Philo, O., $4.15, $4,150; Josiah T. Hart, Harmar, O., $4.40, $4,400; Henry Erbes, Harmar, O., $4.50, $4,500.

Gate Anchorages.—Griffith & Wedge Co., Zanesville, $48 per set, $1,824; Queen City Bridge & Steam Forging Co., Cincinnati, $49, $1,862; L. Schreiber & Sons Co., Cincinnati, $59, $2,242; King Iron Bridge & Mfg. Co., Cleveland, O., $59.50, $2,261; Chester B. Albree, Allegheny, Pa., $63, $2,394; Sharon Boiler Works, Sharon, Pa., $65, $2,470; Charles Barnes, Cincinnati, $73.50, $2,793.

Iron Drift Bolts.—M. Lang & Sons, Pittsburg, Pa., 2.1 cts. per lb. without heads, 2.2 cts. per lb. with button heads, total $1,275.70; Thos. Carlins Sons, Allegheny, Pa., 2.125 cts., 2.25 cts., $1,298.62; Chicago Forge & Bolt Co., Chicago, 2.14 cts., 2.3 cts., $1,321.30; Pittsburg Mfg. Co., Pittsburg, Pa., 2.25 cts., 2.4 cts., $1,382.54; Charles Barnes, Cincinnati, 2.395 cts., 2.395 cts., $1,313.10; Oliver Bros & Phillips, Pittsburg, Pa., 2.4 cts., 2.4 cts., $1,316.05; Central Bolt Works, Cincinnati, 2.45 cts., 2.7 cts., $1,437.20; Queen City Bridge & Steam Forging Co., Cincinnati, 2 47 cts., 2.75 cts., $1,560; L. Schreiber & Sons Co., Cincinnati, 2 75 cts., 3.1 cts., $1,747.87; Z F. Smith, Zanesville, 3.5 cts., 4 cts., $2,248.38; King Iron Bridge & Mfg. Co., Cleveland, O., 3.75 cts., 4.25 cts., $2,385 88.

Street Work.—*Albany, N. Y.* The Board of Contract & Apportionment has awarded contracts as follows: Canal St.: A. N. Brady, Albany, cobble, 91 cts. per sq. yd.; sidewalks, $1.30 per lin. ft.; excavation and filling, 30 cts. and 15 cts. per cu. yd.; new straight and circular curb, 65 and 95 cts. per lin. ft.; resetting old curb, 40 cts.; crosswalks, 20 cts. per sq. ft.; total, $9,894.30.—Norton St.; Jacob Holler, Albany, granite and relaying old blocks, $3.17 and 85 cts. per sq. yd.; straight and circular curb, 95 cts. and $1.25 per lin. ft.; old curb reset, 23 cts.; crosswalks, 10 cts. per sq. ft.; allowance for cobble, curb and crosswalks, 5, 3, and 20 cts.; total, $2,555.82.—Clinton Ave.; John H. O'Rourke, Brooklyn, new and old granite, $3 and $1 per sq. yd.; straight and circular curb, 95 cts. per lin. ft.; old curb reset, 50 cts.; crosswalks, 25 cts. per sq. ft.; allowance for cobble, curb, crosswalks and granite, 1, 1, 20 and 50 cts.; total, $117,039.34.

Cincinnati, O.—The following proposals for paving Jefferson Ave. have been received by F. A. Stanley, City Engineer: Broken stone, E. T. Jarvis, $1,75; B. D. Barton, $1.75; T. J. Peters, $1.75; M. T. Flynn, $1.80; crossing, 70, 65, 65 and 65 cts.; curbs, 70, 68, 75 and 70 cts.; flag gutters, 70, 67, 70 and 75 cts.; grading, 12½, 30, 15 and 35 cts.; bouldering, $1.50, $1.47, $1.60 and $1.44; rolling, 5, 5, 4 and 6 cts.; totals, $33,462.50, $34,915, $35,070, and $35,905.

East Saginaw, Mich.—Contracts have been awarded as follows by John J. Granville, City Engineer: Paving Washington Ave.: John C. Davies, excavation 14 cts. per cu. yd.; curb, 58 cts. per ft.; cedar blocks, 84 cts. per yd.: cobblestone, 85 cts. per yd.; timber, $14 per 1,000 ft. B. M.: culvert covers, $1.75 each: tile drain, $2.25 per rod; total, $5,594.36.—Paving 4th St., Scanlon & Crowley; same materials, 15 cts., 60 cts., 83¼ cts., 89 cts., $15, $2.2.25, $7,323.92.—Paving Hoyt St.: Scanlon & Crowley $3,099.40.—Paving Brewster St., John C. Davies, $7,397.99.—Macadamizing Washington Ave.: Scanlon & Crowley, excavation, 15 cts. per cu. yd.; macadam, 82 cts. per cu. yd.; tile drain, $1.25 per rod; sewer basins, $26 each; total, $4,769.

Proposals Open.

Sidewalks.—Plank and stone. G. H. Cole, City Clerk, Toledo, O. April 23.

Street Work.—On South Main St., taking up and removing 1,500 sq. yds. of cobble pavement, 460 cu. yds. earth excavation, 260 cu. yds. concrete, 108 sq. ft. of 18 in. crosswalk stone, 1,432 sq. yds. granite blocks. On Prairie Ave., removing 608 sq. yds. cobble pavement, 562 cu. yds. earth excavation, 314 sq. ft. of 18 in. crosswalk stone, 2,011 sq. yds. granite blocks. The Board of Public Works, Providence, R. I. April 24.

Bridge Superstructure and Masonry.—Two wrought iron, pin-connected truss and 8 plate girder highway bridges; masonry for 1 truss bridge. Truss spans 55 ft. and 91 ft., 5 and 7 panels, trusses 7 and 10 ft. high Plate girder spans, 28 to 48 ft., depth 30 to 42 ins. Live load for all bridges, 1,700 lbs per lin. ft; static load 630 to 660 for plate girders, 640 and 820 lbs for trusses. Clear width, 17 ft. Masonry, 4,500 cu. yds.; price per cu. yd. in place, to include excavation, pumping, shoring, coffer dams, etc. Plans and specifications at the office of Charles' Davis, County Engineer, Pittsburg. Josiah Speer, County Controller, Pittsburg, Pa. April 25.

Harvard Bridge. Masonry abutments for the Harvard bridge, over Charles river, between Boston and Cambridge. Plans and specifications at the office of the City Engineer, Boston. Hugh O'Brien, Chairman, Commissioners of Harvard Bridge, City Hall, Boston, Mass. April 25.

Street Work and Sewers.—Earth and rock excavation, filling, curbing, flagging, dry rubble masonry, rubble masonry in mortar, granite block paving; 12-in. pipe sewer, house connections, manholes, concrete; brick sewer 43¾ ins. × 28¾ ins.; concrete and mortar paving; lumber; asphalt tile pavement. The Parks Commissioners, 49-51 Chambers St., New York City. April 25.

Bridge.—Superstructure of iron foot bridge in Forest Park. Henry Flad, President, Board of Public Improvements, St. Louis, Mo. April 26.

Pipe Laying.—Excavating, hauling and laying 2,400 lin. ft. of 36-in. water pipe, 40 ft. of 12-in., 60 ft. of 6 in., and setting 1 fire plug: Also furnishing 1,500 lbs. of wrought straps, bands and bolts in place. Henry Flad, President, Board of Public Improvements, St. Louis, Mo. April 26.

Removing Wrecks.—Three wrecks in Mattaponi river, Va. Gen. S. T. Abert, U. S. Agent, U. S. Engineer Office, Washington, D. C. April 28.

Artesian Well.—Plans and specifications at the office of the City Engineer. G. H. Cole, City Clerk, Toledo, O. April 30.

Street Work.—Grading, culverts, etc. G. H. COLE, City Clerk, Toledo, O. April 30.

Water-Works Debentures.—Purchase of $130,000 of the city of Charlottetown water-works debentures. Proposals for the whole or part. D. LAIRD, Chairman, Water Commissioners, Charlottetown, P. E. I., Canada. April 30.

Dam.—At Whitinsville, Mass. Embankment dam, 370 ft. long, 15 ft. high above foundations; plans and estimates furnished. Also bids per cubic yard for road filling. A. C. MOORE, C. E., 100 Main St., Southbridge, Mass. May 1.

Bridge.—Iron highway bridge over the Trinity river; 2 wrought iron spans of 125 ft and 50 ft., resting on wrought-iron cylinder foundations; 464 lin. ft. of wrought-iron trestle approach. Plans and specification on application. W. B. KING, City Engineer, Fort Worth, Tex. May 1.

Gas Works.—Erection and operation of gas works for lighting the public streets of the borough for a term of years, and for furnishing illuminating or fuel gas, or both, for private consumption in the borough. D. S. STETSON, Chairman Gas Committee, Merchantville, N. J. May 1.

Steam Propellor.—Small wooden sea-going passenger steamer of 100 tons burden. EDWARD BURGESS, 22 Congress St., Boston, Mass.; or Major O. H. ERNST, U. S. Engineer Office, Galveston, Tex. May 5.

Pipe, Pumping Engine, Stand-Pipe, Etc. About 1,500 tons of cast iron pipe, with bends, branches, etc.; 100 hydrants, 100 stop valves, 27 tons pig lead. Steam pumping engine with capacity of 2,000,000 gals. per 12 hours. Steel water tower, 40 ft. diameter, 80 ft. high. Plans and specifications on file. T. O. BOLGER, City Engineer, Water-Works Department, Kingston, Ont., Canada. May 8.

Water-Works.—Complete system. W. H. STAIR, Engineer. Plans and specifications on file. GEO. E. POND, Asst. Q. M., U. S. A., Fort Riley, Kan. May 9.

Culvert.—Stone culvert, 9 ft. wide, 6 ft. high, 200 ft. long, with wing walls. Plans and specifications on file. W. H. STAIR, Engineer. GEO. E. POND, Asst. Q. M., U. S. A., Fort Riley, Kan. May 9,

WATER.

American Water-Works Association.—Our Mr. FROST, with a stenographer, has attended the meetings of the association at Cleveland on the 17th, 18th and 19th, and ENGINEERING NEWS of next week will be a *special water-works issue*, containing as carefully prepared and full a report of the convention as can be made in one issue. Abstracts only of the papers read will be published—full text would be impracticable—but special attention will be given to the discussions, the always valuable and very practical feature of the convention. A full list of members in attendance will be published; and especially a list of associate members and their exhibits, or the firm and business represented. This issue will be so especially interesting to the water-works interests that it will be carefully preserved for future reference. In addition to the regular edition, which is greater than that of any other engineering journal in America, a copy will be placed in every water-works office of which we can obtain the address, in North and South America, especial attention being given to new works not yet listed except in our own indices.

In view of this we solicit full page, half page or quarter page, special advertisements for this one issue. The prices are $30 for one full page, $20 for half page, and $15 for quarter page. No special location will be assigned. Forms will go to press on the 26th without fail. Manufacturers of Special Water-Works Machinery ought not to miss this opportunity to bring the notice of their goods to the parties whose trade they specially desire. Address, without delay, ENGINEERING NEWS PUBLISHING CO., Tribune Building, New York City.

Malone, N. Y.— April 16, 1888.

EDITOR ENGINEERING NEWS:—We find that our water supply and size of pipes are inadequate, and we now propose to increase both. Have purchased 3 large springs, all located within a few rods of each other, distant about 8 miles from town. Shall lay 10-in. cast-iron pipe to a reservoir near the village, 20 x 200 x 10 ft., and 12-in. pipe from reservoir to village. We expect to be able to furnish 10,000 people with 60 galls. each daily. Shall repipe the streets with 10, 8, 6 and 4 in. cast iron pipes, and set up 55 hydrants to commence with. Have not let the contract yet, but shall do so soon. Expect the expenditure to be about $90 000. D. M. GREEN, of Troy, N. Y., is drawing our plans and we shall have the works begun at once. Our new supply of water is said by the chemist to be as good as, if not the best, in the State. I can send you later the name of contractor, etc. When completed we shall have 14 miles of new pipe, and perhaps more; our old line is about 12 miles long, mostly of cement pipe.

GEO. SABIN, *Superintendent*,
Malone Water-Works Co.

Montreal, Canada.—The Superintendent of Water-Works, LOUIS LESAGE, has completed his annual report. He states that the present aqueduct is inadequate and that the longer delay in constructing the projected large aqueduct, means heavy expenditure in the near future for steam power. Last year 75% of the water used was pumped by water power and cost for pumping $5,500; the other 25% by steam power, cost $23,700. These figures are significant, especially when taken in connection with the fact that the limit of the pumping power of the aqueduct having been reached some years since, the percentage pumped by water-power decreases annually, whilst that by steam of course increases proportionally. The total amount pumped during the year, both by water and steam, was 4,765,041,000. The new Gilbert engine, with a daily capacity of 2,000,000, galls. is being put in place.

The Drainage Pumps at Montreal.—The Inundation Committee recently visited the new pumping stations, both of which are now completed. They are built of stone. In the east station there are 4 pumps, 24 ins. in diameter, driven by two pairs of high pressure automatic engines of 150 H. P. each. These pumps have a capacity of 74,000 galls. There are 5 horizontal steel boilers, 15 ft. long and 5 ft. 6 ins. diameter, with 78 3¼-in. tubes. The engines were tested by closing the penstock gate, causing the water to rise in the sewer till the gauge registered 12½ ft. The sewage was quickly pumped out by 2 of the engines. At the Mill St. station, which was next visited, there are 2 15-in. pumps, with a capacity of 28,000 galls., driven by a pair of automatic engines.

Reading, Pa.—An ordinance is proposed to authorize the Committee on Finance to borrow the sum of $50,000, for the purpose of increasing the water supply of the city, and to make an appropriation to the Department of Water to erect a pumping station on the banks of the Schuylkill river, to lay necessary main pipes, etc., according to such plans and specifications as may be adopted. The reason of this is that the water supply of the city is inadequate for the present requirements of the public and the deficiency is so great at certain seasons of the year as to imperil not only the convenience and comfort of the citizens, but the protection of property from loss by conflagration, and public opinion has strongly indicated the Schuylkill river as the best source of additional supply. Coupon bonds, at 4 per cent, for this amount, will be issued, to be called "The Schuylkill River Loan of 1888." The ordinance provides that the sum of $65,000, being the $50,000 realized from the sale of the bonds, and an additional sum of $15,000, out of the funds of the Department of Water, shall be appropriated, provided, however, that the appropriation shall not be available until the Commissioners of Water have presented to the Council plans and specifications for the proposed work.

New Water-Works.—*Massachusetts.*—Everett. A new reservoir is to be built at a cost of $10,000.——Malden. At a recent meeting of the Common Council an order from the Aldermen in acceptance of the legislative act granting permission to Malden to take additional water supply was laid upon the table in non-concurrence, pending the report of the engineer and water commissioner appointed to investigate Eaton's wells.——Randolph. The new works were successfully tested April 16. The hydrant pressure was 80 lbs and it was shown that a ¾ in. stream could be thrown over any building in town. A final test with the steam fire engines will be made. It has been voted to issue 30 year 4 per cent. water bonds for $20,000. Among the appropriations for the year are $4 000 for interest on the water loan, and $2,500 for water for hydrants, street service, etc.——Woburn. The town has appropriated $7,450 for hydrant service, $2,000 for water-works construction and $2,365 for water mains.

Rhode Island.—Central Falls. The matter of laying new water pipes has been referred to the committee on hydrants.——Burrillville. The voters of the Pascoag fire district had a meeting April 9, to discuss the water-works question and a committee was appointed to confer with the Burrillville Water Supply Co. about a satisfactory contract. A test vote resulted in 88 in favor of and 50 opposed to a water supply.

Connecticut.—Windsor Locks. C. L. GOODHUE, of Goodhue & Birnie, water-works contractors, has reported that a sufficient supply of good water can be obtained from Kettle brook.

New York.—Clyde. At the recent vote on the question of water-works, 200 votes were cast; 105 in favor and 104 against.——Little Falls. The water-works are expected to be finished by July 15; of the 17 miles of pipe only 4 remain to be laid.——Ellensburg. Water-works are to be constructed.——Rockaway Beach. The Queens County Water Co., which supplies Hempstead and Far Rockaway, L. I., has been enjoined from extending its system to Rockaway Beach. The Supreme Court has made the injunction permanent.

Pennsylvania.—Lancaster. The Water Commissioners paid their first official visit on April 11, going to the new water-works site, and to other points in the line of their duty. It is expected that the first pump at the new works will be in operation by June 1, and the old 3,000,000 galls. pump will be changed by the Worthington Company to a 5,000,000 galls. pump. The east reservoir has been found to be leaky and in generally bad condition, and the Commissioners will favor the erection, at an early day, of a 20,000,000 galls. reservoir west of Franklin and Marshall College.——Reading. An ordinance has been introduced to authorize the Committee on Finance to borrow $50,000 for increasing the water supply.

Ohio.—Norwalk. A compromise on the water-works bonding measure has been secured. It is now proposed to procure a special election for the purpose of voting to bond the city to the amount of $15,000, the proceeds to be used in needed repairs on the present works, and in experimenting for a supply with the drive well system. A bill has been introduced in the Ohio Legislature authorizing the city to issue bonds for a sum not exceeding $15,000, the money to be used in testing the driven well system, and making necessary repairs at the water-works. Before proceeding with the improvement, however, the proposition to issue bonds must first be submitted to a vote of the qualified electors of the place.

Indiana.—Fort Wayne. Two of the water-works trustees have resigned, and the term of the remaining one expires this spring. A new board will have to be elected. The cause of the resignations is said to be the opposition of the Council to the issue of water bonds.

Virginia.—Roanoke. The first annual meeting of the stockholders of the Roanoke Water-Works, will be held May 2. H. E. GERHARD, Secretary.

West Virginia.—Moundsville. Water-works are contemplated.

North Carolina.—Durham. The water-works are completed and have been accepted.——Washington. The artesian well is now in use 250 ft. deep.

Kentucky.—Pineville. Water and gas works are projected; separate companies have been organized.——Paris. The city has voted 399 in favor of water-works and 36 in opposition. The works are to be in operation by Nov. 1.

Florida.—Tallahassee. Water-works are contemplated, and a committee has been appointed to obtain information. Address B.A. MCGINNIS.

Illinois.—Lake View.—City Engineer JOHN W. ALVORD recommends the construction of a tunnel from the pumping station to a submerged crib at least 1 mile from the shore.

Minnesota.—Winona.—The annual report of the Water Commissioner, published April 10, shows that 5,349 ft. of water-pipe were laid, making a total of 16 miles, 2,629 ft. There are now in use 171 hydrants and there are 840 consumers. During the year there were 432 391,497 galls. of water pumped. The receipts are $1,469.21 over last year and $3,306.04 over the year before.

Missouri.—Washington. The Committee on Water-Works have had a circular letter printed, setting forth that they will receive bids until May 10, for the construction and maintenance of a system of water-works on the franchise plan, the franchise to run for 20 years. The city reserves the right at the expiration of 10, 15, or 20 years to purchase the works at an appraised valuation; the water to be pumped from the Missouri river and the pumping machinery to have an aggregate capacity of not less than 1,500,000 galls. in 24 hours. To supply the city with water will require 4 miles of mains.

Kansas.—Eureka. The proposition to vote $10,000 in bonds for water-works has been carried by a large majority.

Nebraska.—Valparaiso. The new water-works are now completed and several tests have been made.

Colorado.—Glenwood Springs. Work has been resumed actively on the completion of the water-works for the town. The mains have arrived and MASON W. MATHER, the Engineer in Charge, has let the contracts for digging the trenches. Contracts have been let for the lumber for the 2 miles of flume for conveying the water from No Name creek to the head of the pipe lines, and also for grading for the flume and building it. It will be completed in May.

Montana.—Benton. A preliminary test of the water-works, which were built by GEO. S. WOOLSTON, of Boston, has been made. Two streams were thrown to a height of over 100 ft.——Helena. The city is jubilant over its new water supply. It was for a long time thought that the only plan was to obtain a supply from the Missouri river, entailing costly works. The new supply, furnished by G. S. WOOLSTON, is derived from artesian wells.

Oregon.—Milton. The water-works question was submitted to a vote of the people on April 9, and was carried by an overwhelming majority. A good, substantial plant, for fire protection and domestic use, will be put in immediately.

Texas.—Brady. A company has been organized to establish water-works. The supply will probably be obtained from artesian wells.

The New Jersey Superheated Water Co., of Newark, N. J., has secured the passage of an ordinance granting it the right to lay its pipes in the streets of that city. The company is to be liable to the city for damage to the streets by explosion or leakage.

Pipe Scraper and Cleaner.—Kear and Lawrence, of Minersville, Pa., are prepared to take contracts for cleaning water or sewer pipes, or to sell the right to use their patent cleaner. They cleaned 3 miles of the Minersville Water Co.'s main line in 26 days, without materially interfering with the supply; the pressure was only 5 lbs. when the work commenced, but was 130 lbs. when finished. Further particulars may be obtained from the firm.

New Orleans, La.—The City Engineer, D. M. BROSNAN, has reported with regard to the proposed Jouet system of draining the city that a large canal, about 125 ft. wide, through the rear of the city, connecting the Mississippi river with Lake Borgne, would be of no benefit as a navigation and drainage canal, for the reason that while a drainage canal should be practically dry, a navigation canal should be full of water; no additional wharfage is needed. Mr. BROSNAN approves of a drainage canal on the proposed line, with pumping machinery to remove the water.

Huntington, W. Va.—

PITTSBURG, Pa., April 14, 1888.

EDITOR ENGINEERING NEWS:—We note in your late issue an item stating that there is some question about the Huntington water-works being accepted, having failed at their test. The facts are that we had a very successful test in January. Our pump capacity is almost double the franchise requirements, and is in good shape. The difficulty has been that in the recent high water in the Ohio river we have had trouble to keep our suction pipes open and free from sand, which will necessitate some changes in our method of taking water from the river; these changes will be made as soon as the river falls. We have kept the town fully protected all the while, and have put out all the fires they have had, promptly and to the satisfaction of everybody; and so far we have discovered no dissatisfaction with the water works in any respect.

Yours very truly, W. S. KUHNS, *Gen. Mgr.*
American Water-Works & Guarantee Co.

The Trinchera Canal Co. has been incorporated at Denver, Col., to purchase and operate irrigation ditches in Costilla Co.; it proposes to take water from the Rio Trinchera, Sangre de Christo and Ute creeks. The directors are, W. H. GESELBRACHT, A. R. BEVAN, and W. A. BELL; capital stock, $50,000; offices at Colorado Springs, Col.

Philadelphia, Pa.—The following is from the report of Director WAGNER, of the Department of Public Works:

Bureau of Water.—The furnishing of an abundant supply of clean and pure water to our citizens is the most important subject which demands our consideration. While we are suffering from its bad condition, I am happy to state that with the appropriation of $100 000 made last year, the first section of the reservoir in the East park has been completed, increasing our storage capacity 60,000,000 galls. An appropriation made this year of $400,000 has enabled us to enter into contracts for finishing the second section, which will contain over 300,000,000 galls. It is the intention of the Director of the Department of Public Works to press this to completion as rapidly as possible. During the year 1889, with the appropriation which we have every reason to expect your honorable bodies to make, the third and last section can be finished. The city will then have an additional storage capacity of 700,000,000 galls. which, with our present basins, holding 200,000,000 galls., will give us subsiding reservoirs sufficient at all times to furnish a clean supply of water and allow our pumps to remain idle until the storm water has passed out of the rivers. Our pumping capacity is equal to our requirements for some years. The new Holly engine is working to the entire satisfaction of the department and is developing a larger capacity than the contract calls for. Our other engines are in good serviceable condition.

Annual Reports.

Medford, Mass.—The Water Commissioners have issued their 18th annual report, dated Feb. 1, 1888. The quantity of the water supply has been sufficient, but the quality was bad during the summer. A new source of supply is recommended and investigations are being made by Mr. BALL, C. E. The Superintendent states that cement-lined pipe, if properly made and laid, is better than cast-iron, as it does not corrode or rust, and costs less to make. During the year 5,389 ft. of pipe were laid, making a total of 37 miles 2,958 ft.; 8 hydrants were set, total, 181; 9 gates were set, total, 293; 114 services were put in; 1 meter was set, total 9. R. M. Gow is Superintendent.

Hartford, Conn.—The Water Commissioners have issued their report for the year ending March 1, 1888, being their 34th annual report. The water supply, which is obtained from mountain springs, has been ample in quantity and excellent in quality, and it has not been necessary to resort to pumping from the Connecticut river. During the year, 15,733 ft. of cast-iron mains were laid, including 5,311 to replace cement-lined sheet-iron pipes; 11 hydrants and 13 gates have been set; also 20 meters and 160 new services. There are now 476 hydrants, 737 gates, 20 meters and 5,836 services. The report contains tables of rainfall, capacity of reservoirs, etc., and a portrait of W. G. BULKELEY. EZRA CLARK is President and Superintendent; HERBERT W. AYRES, Engineer in charge of the reservoirs.

Richmond, Va.—The Superintendent of the City Water Works, C. E. BOLLING, has issued his report for 1887, being his 3rd annual report. The water has been good, though at times discolored; a storage lake with a capacity of 200,000,000 galls., or 20 days supply, is recommended. Methods of preventing waste are also recommended. During the year 26,621 ft. of 3 to 20-in. pipe were laid, and 28 hydrants and 66 stop valves set, also 27 meters and 806 taps. There are now 348,610 ft. of 1½ to 30-in. distribution pipe, 455 hydrants and 66 meters. The hydrant pressure ranges from 15 to 60 lbs. The total amount of water pumped to the reservoirs was 4,078,516,290 galls. The cost for pumping was $8.33 per 1,000,000 galls. by the steam pump, $3.89 by the new water pumps, and $5.42 by the old water power pumps.

Lynn, Mass.—The Public Water Board has issued its report for 1887, being the 16th annual report. The storage capacity of the ponds is 561,786,000 galls. and the construction of additional storage basins is recommended. An additional pumping engine is recommended. The tube wells have not been in use, but the engine has been kept in readiness for an emergency; it is stated, however, that it is doubtful if the gang of wells could be depended upon, and they would probably have to be renewed if required to be put in use again. During the year 2 miles 2,406 ft. of pipe were laid and 7 miles 3,960 ft. in Saugus; the distribution system supplied by the works comprises 81 miles 782 ft. in Lynn, 8 miles 4,490 ft. in Saugus, 1,778 ft. of private pipe in Swampscott; total, 90 miles 1,779 ft. There were 18 hydrants and 28 gates set; totals 590 and 636. Saugus has 80 hydrants. The works are owned by the city and were built 1870-1872. The supply is obtained from 2 artificial storage basins, and 2 brooks in North Saugus. The water flows by gravity to the pump well and is pumped to a reservoir at an elevation of 177 ft. above mean tide. There is an engine of 5,000,000 galls. daily capacity, built by I. P. Morris & Co., of Philadelphia, and another by the Deane Steam Pump Co., of Holyoke, Mass., with a daily capacity of 3,000,000 galls. The total pumpage was 867,711,768 galls. The distribution pipes are 4 to 16 in., wrought-iron cement lined, and cast-iron; the service pipes are ¾ to 2 ins., wrought-iron cement lined. The population is 49,500, 48,000 supplied. The report contains tables of meteorological records, etc. D. H. SWEETZER is President; DANIEL WALDEN is Superintendent.

Bay City, Mich.—E. L. DUNBAR, Superintendent of the Water-Works, has issued his report for 1887, being the 16th annual report. The supply is obtained from Saginaw bay, with a connection with the river for emergencies. An increased supply from the bay and the establishment of a filtering plant are recommended. The works were built in 1872 and are owned by the city. The supply is by direct pumping from Saginaw bay; Holly engines are used. The mains are of cast iron and Wyckoff patent, 3 to 20 ins. diameter; 8,108¾ ft. have been added and 37½ ft. abandoned; total 25½ miles; 10 hydrants and 12 gates added, totals 190 and 360. The services are lead, iron and Wyckoff, ¾ to 8 ins. diameter; 16 meters added, total 190. The pressure is 28 to 33 lbs. The population is 33,000, 10,500 supplied. Total consumption, 827,195,009 galls.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

(CONTINUED FROM PAGE 304).

Kendallville, Ind.—The works were commenced Oct. 15, 1887, and completed Dec. 31, 1887. They were designed by J. D. COOK, of Toledo, O. The pumping machinery was supplied by the Knowles Steam Pump Co., of New York; the pipe, specials and hydrants by R. D. Wood & Co., of Philadelphia, Pa.; the valves by J. Flower & Bro., of Detroit, Mich.; and the trenching and pipe laying was done by Snyder & Williams, of Dayton, O. The supply is by direct pumping from a well; there is a compound, non-condensing, pumping engine of 750,000 galls. daily capacity, and 2 horizontal tubular boilers. There are 2 miles of cast-iron pipe and 18 hydrants; the service pipes are of wrought-iron. Ordinary pressure, 50 lbs.; fire pressure, 90 to 100 lbs. The cost of the works were about $16,000; debt, $13,000; rate of interest, 6 per cent. The works are owned by the city. H. KRUEGER is Superintendent, and D. C. WALLING is President of the Water Board. The present population is 3,000.

Lowell, Mich.—The franchise was granted Aug. 10, 1887, and the works were accepted in January, 1888. The engineer was A. C. SEKELL. The company put up the buildings, did the trenching and pipe laying, and built the masonry reservoir. The pumping machinery was supplied by Smith, Vaile & Co., of Dayton, O.; the pipe and specials by the Detroit Pipe & Foundry Co., of Detroit, Mich.; and the valves and hydrants by the Chapman Valve Mfg. Co., of Indian Orchard, Mass. The supply is drawn from a gang of 20 driven wells and pumped to a reservoir 34 ft. diameter, with a depth of 8 ft. of water. The pump is a duplex, high pressure engine, 14×9×10, with a 40 H. P. vertical boiler. There are 3.63 miles of cast-iron pipe and 50 hydrants; the service pipes are of of lead and iron. Ordinary and fire pressure, 65 lbs. The works cost about $22,000. The works are owned by the Lowell Water Co., at Grand Rapids, Mich.; stock, $30,000; bonds to be authorized, $30,000. The village pays $30 per hydrant per annum for the 50 hydrants. President, E. F. SWEET; Vice President, E. W. WITHEY; Secretary, EDGAR W. FORD; Treasurer, JOHN E. MORE; Superintendent and Manager, A. C. SEKELL. The present population is 2,500.

Hayward, Wis.—The works were commenced Oct. 15, 1887, and completed Jan. 5, 1888; they were designed by H. H. HARRISON, of Stillwater, Minn. The buildings, trenching and pipe laying were done by the company; the pumping machinery was furnished by the Knowles Steam Pump Co., of New York; the pipe and specials by the Buffalo Cast Iron Pipe Co., of Buffalo, N. Y., and the valves and hydrants by the Galvin Brass & Iron Works, of Detroit, Mich. The supply is by direct pumping from the Namakagon river, by an engine of 1,250,000 galls. daily capacity, with 2 tubular boilers, 48 ins. diameter and 14 ft. long, with 34 3-in. tubes. There are 1¼ miles of cast-iron pipe, 18 taps and 18 hydrants; the service pipes are of wrought-iron. The ordinary pressure is 35 lbs; fire pressure, 80 lbs. The works cost $20,000, and the rate of interest is 10 per cent.; they are owned by a private company. THEO. BUNKER is Superintendent. The present population is 1,500.

Council Grove, Kan.—The works were commenced in August, 1887; tested Feb. 16, and accepted from Feb. 1, 1888. The engineer was W. E. ALLEN, of New York and Council Grove. The contractors were as follows: for masonry and foundations, J. Jones, Council Grove; buildings, C. Fowler; pumping machinery, Davidson Steam Pump Co., New York; pipe, Chattanooga Foundry & Pipe Works, Chattanooga, Tenn.; specials, Builders' Iron Foundry, Providence, R. I.; valves and hydrants, Ludlow Valve Mfg. Co., Troy, N. Y.; stand-pipe, 75 ft. high, Shickle, Harrison & Howard, St. Louis, Mo. The trenching and pipe laying was done by the company by day labor. The franchise is for 21 years, and the hydrant rental is $70. The franchise is owned by the Council Grove Water Co., of New York; President, DANIEL RUNKLE; Secretary, W. E. STIGER; Superintendent, F. S. ARMSTRONG. The population is 3,800.

Sterling, Kan.—The works were completed in September, 1887, the engineer was JOHN W. NIER, of Kanas City, Mo. The contractors for masonry, foundations and buildings were Heffner & Allington, of Sterling; for pumping machinery, Deane Steam Pump Co., of St. Louis, Mo.; for boilers, H. C. Darby; for pipe and specials, Chattanooga Foundry & Pipe Works, of Chattanooga, Tenn.; for valves and hydrants, Galvin Brass & Iron Works, of Detroit, Mich.; for trenching and pipe laying, Owen & Dryland, of Sterling. The supply is drawn from 38 driven wells, 2 ins. diameter, and pumped direct by an engine of 1,000,000 galls. daily capacity. There are 4¾ miles of 4, 6, 8 and 10-in. pipe, 100 taps and 38 meters; the service pipes are ⅝, ¾, 1¼ and 2¼-in. diameter. Ordinary pressure, 40 lbs.; fire pressure, 160 lbs. The works cost $50,000; debt, $42,000; rate of interest, 6 per cent. The works have only been in operation about 6 months, and as the Water Commissioner is daily putting in services, the number of consumers cannot be given, but is estimated at 100, which number is expected to be doubled by July. The hydrant rental is $5 per 25 ft. front; $2 additional 25 ft.; $1.50 next 25 ft., and so on. The works are owned by the city, which has issued bonds for $42,000; P. P. TRUEHEART is Mayor. The Superintendent is ALBERT HOUCK, of Kansas City, Mo. The present population is 2,800.

(TO BE CONTINUED).